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TRANSACTIONS

OF THE

ROYAL ENTOMOLOGICAL SOCIETY

OF

LONDON

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THE RELATIONS OF ANTS WITH INSECTS ATTACKING CERTAIN POISONOUS PLANTS IN HAWAII*

By J. S. PHILLIPS, M.C., M.A., B.SC., PH.D.

[Read 6th December, 1933.]

WHILE working on ants in the Hawaiian Islands, my attention was attracted to an extremely interesting paper by Jones (1), in which he found that ants would not eat certain insects or extracts of them mixed with otherwise palatable food. He noticed "that the food of the insects found to possess these ant-deterrents consists of the leaves and juices of related acrid and poisonous plants; and that the circumstances of its occurrence indicate that the deterrent is derived from the food plant, if not identical with the poisons." The plants referred to were members of the families Asclepiadaceae and Apocynaceae, plants with abundant, acrid and poisonous milky juices.

It occurred to me that if the species of these families found in Hawaii had similar effects, they or extracts from them might be used locally as ant repellents. Furthermore, it seemed important to determine whether any sap-sucking insects feeding on such plants had ants attending them. If the plant juices were in fact ant repellent, the excreta of the aphids and coccids feeding on them might be equally repellent, in which case they would presumably be unattended by ants.

Accordingly, a number of these plants were examined with the following results:—

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* Published with the approval of the Director as Technical Paper No. 64 of the Experiment Station of the Association of Hawaiian Canners, University of Hawaii.

Some Hawaiian Poisonous Plants Attacked by Sucking Insects with Their Attendant Ants.

Plant.	Type of Heteropteron.	Species of Attendant Ant.
Apocynaceae.		
Plumeria acutifolia.	Aphid.	*Pheidole megacephala.*
	Scales (2 spp.).	*Plagiolepis mactavishi.*
Nerium oleander.	**Mealy bug.	*Prenolepis longicornis.*
	Scales (2 spp.).	
Allamanda hendersoni.	Scale—a few only.	No ants observed.
Allamanda cathartica.	Scale.	*Plagiolepis mactavishi.*
	**Mealy bug.	*Plagiolepis mactavishi.*
Alyxia olivaeformis.	Scale.	No ants observed.
Thevetia nereifolia.	Scale—a few only.	No ants observed.
Asclepiadaceae.		
Calotropis gigantea.	Aphid.	*Pheidole megacephala.*
Stephanotis floribunda.	Mealy bug.	Ants not observed.
	Scale.	No record. [Reported (3) not observed personally.]
Euphorbiaceae.		
Ricinus communis	Aphid.	*Pheidole megacephala.*
	Leafhopper.	*Plagiolepis mactavishi.*
**Euphorbia hirta.*	Aphid.	*Prenolepis longicornis.*
		Pheidole megacephala.

Plant names are taken from (3), except that marked * which is from (4).
***Pseudococcus longispinus.*

In addition to members of the two families previously mentioned, two poisonous plants of the Euphorbiaceae have been included. Gobbato (2) reports that the natives in Brazil grow castor-oil plants in their gardens to protect the other plants from ants and he also recommends burning the seeds as an ant fumigant. The castor-oil plant is abundant here and was therefore included in the list of plants examined as well as *Euphorbia hirta*, a representative of the same family.

The fact that most of the reputedly poisonous-leaved plants nourish phytophagous insects, the excretions of some of which in turn are consumed by ants, seems to show either that insects are immune to these vegetable poisons or else that the plant feeders obtain their nourishment from specialised, non-poisonous parts of the plant. In case the latter reason proved to be the correct one and as ants and other insects are known to be affected by a number of vegetable poisons, it was decided to see whether extracts of these plants were deterrent to ants and more particularly to *Pheidole megacephala*.

Accordingly, parts of the following plants (stem, seeds and leaves) were stewed in a ten per cent. ethyl alcohol solution; the infusions were then drained and the resulting liquids mixed with a bait of biscuit and chocolate. The cakes were then placed in definite and equal areas, with a control of biscuit and chocolate only, and a similar cake, mixed with a few drops of nitrobenzene.

The baits used in the areas, which were so placed as to be all equally exposed to ant attack, were as follows :—

(i) *Allamanda hendersoni.*
(ii) *Nerium oleander.*
(iii) *Thevetia nereifolia.*

(iv) *Calotropis gigantia.*
(v) *Plumeria acutifolia.*
(vi) *Ricinus communis.*
(vii) *Euphorbia hirta.*
(viii) Control.
(ix) Nitrobenzene.

Baits (ii), (v), (vi) and (vii) were eaten as readily as the control and were entirely consumed in two days; (i) was also attacked but rather less readily and lasted four days; (iii) and (iv) did seem to have a somewhat deterrent effect and were not entirely eaten until about a week after the start of the experiment. But not one of these home-made plant extracts was comparable in effectiveness with nitrobenzene, which remained effective fully three weeks and was then only dissipated by the combined effects of rain and wind.

However, the test showed that there did appear to be a deterrent principle in at least two of the plants tested, and possibly with adequate methods of extraction and concentration effective ant-repellent plant extracts could be made from them.

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(1) Jones, F. M., 1932, Insect coloration and the relative acceptability of insects to birds. Trans. ent. Soc. Lond., **80** : 345–386.

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(3) Neal, M. C., and Metzger, B., 1929, In Honolulu gardens. Bishop Museum, Honolulu.

(4) Pope, W. T., 1929, Manual of wayside plants of Hawaii. Advertiser Publishing Co., Ltd., Honolulu.

OBSERVATIONS ON THE STRUCTURE, BIOLOGY AND SYSTEMATIC POSITION OF *PANTOPHTHALMUS TABANINUS* THUNB. (DIPTERA PANTOPHTHALMIDAE)

By W. H. Thorpe, M.A., Ph.D., Jesus College, Cambridge.

(From the Zoological Laboratory, Cambridge, Sub-Dept. of Entomology.)

[Read 4th October, 1933.]

With Twenty Text-figures.

Introduction.

The family Pantophthalmidae (Acanthomeridae) is unique among the Diptera on account of the great size attained by several of the species. They are without doubt the largest Diptera known and are among the largest living insects.

Till comparatively recently little was known of their life-history, but the work of Fiebrig (1906), Navarro de Andrade (1930) and Greene and Urich (1931) has brought to light many facts of biological interest. Austen (1923) has revised the family.

The Pantophthalmidae are known to occur in the neotropical region from Mexico on the north to Paraguay on the south, including the West Indian Islands. De Andrade from a study of altitudinal distribution of *Pantophthalmus pictus* in Brazil believes that the family will eventually be found to be represented in all the countries of South America.

A study of the external structure of the adult indicates affinity with the Stratiomyidae and the Leptidae (especially Xylophagidae and Coenomyidae) on the one hand, and with the Tabanidae on the other.

Of the thirty or more known species two only have been studied from the biological standpoint. *Pantophthalmus pictus* Wied, (*Acanthomera teretruncum* Fieb.) and *P. tabaninus* Thunb. The eggs in each case are laid in clusters in crevices of the bark of trees. The young larvae commence boring either in a crack or in the deserted hole of a bark beetle. They apparently subsist chiefly, if not entirely, upon the fermenting sap which accumulates in their burrows. The burrows are kept open and enlarged as the larva grows, the wood fibres which are rasped off by the mouth-parts being pushed backwards out of the burrow by means of the heavy posterior shield (fig. 1), which is armed with tufts of bristles. The larva eventually pupates in a specially constructed chamber " squared off " from the main burrow. When ready to emerge the pupae work their way to the surface of the log.

The life of the adult is short, varying from two to fifteen days. Urich states that " the mouth-parts and digestive system of both sexes are degenerate and seem incapable of being used for feeding or digestion." Neither Fiebrig nor de Andrade make any mention of this matter.

The development is slow, the entire life cycle taking from 5½–12 months in the case of *P. tabaninus* and from 22–28 months in *P. pictus*.

It appears that *P. tabaninus* attacks only dying or recently felled trees.

P. pictus, on the other hand, infests otherwise healthy trees and is somewhat troublesome as a forestry pest in Brazil.

In spite of the work of the authors mentioned above, there still remain many points the investigation of which might be expected to throw further light on the systematic position and bionomics of these remarkable insects, and the writer, at the suggestion of Dr. A. D. Imms, F.R.S., accordingly took advantage of a recent visit to Trinidad to obtain material and make observations. In particular it was thought desirable to make further studies on the larval mouth-parts and their musculature, and on the " finger-like organ " which is such a striking feature of the mature larva (fig. 1).

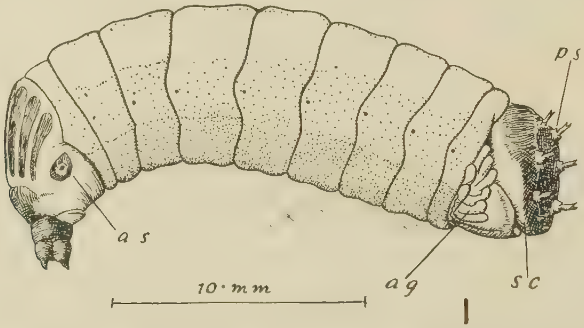

Fig. 1.—*P. tabaninus.* Full-grown larva. a g = anal tracheal gills; a s = anterior spiracles; p s = posterior shield; s c = spiracular cleft.

The dots on segments 3–10 inclusive indicate the position of the rudimentary lateral spiracles.

The mouth-parts, alimentary canal and genitalia of the adult were also studied, since nothing whatever is known concerning the internal anatomy of the Pantophthalmidae and since these structures might be expected to exhibit special modifications connected with the curious mode of life.

With the kind assistance of Mr. F. W. Urich of the Dept. of Entomology, Imperial College of Tropical Agriculture, St. Augustine, to whom I am very much indebted for help in this and many other matters, I was able to get living material of the larva from fallen *Erythrina* trees. It is a difficult and laborious matter extracting the larvae uninjured from the trees, and this made it impossible, in the short time available, to secure sufficient material for all the experiments it would have been desirable to carry out. To obtain adults, logs were cut from the trees, brought down to the laboratory and stored in an outdoor insectary so that the flies could be caught on emergence.

Material for dissection was preserved with moderate success in Pampel's Fluid (Imms, 1929), Bouins' Fluid and 90 per cent. alcohol were also employed.

MORPHOLOGY OF LARVA.

The general external anatomy of the larva has already been admirably described by Greene and Urich, and the main features are shown in the illustration (fig. 1).

The mouth-parts of the larva, which are shown in figs. 2–5, comprise a large projecting horn-like median piece or labrum, a pair of powerful maxillae at the base of which lie the two-jointed antennae, and a median labium which lies hidden between the maxillae.

The labrum viewed dorsally (fig. 2) shows a bluntly toothed auger-like apex. From the underside, some little way back from the tip, arises a tuft of forwardly pointing bristles (fig. 5).

The conspicuous paired mouth-parts are referred to by Greene as mandibles, but since each bears a minute two-jointed palp I have called them maxillae. The presence of only one pair of mouth-parts is, as far as I am aware, peculiar to the PANTOPHTHALMIDAE among the Brachycera. In the ASILIDAE, some of which show a superficial resemblance to this family, two pairs are present; a large outer pair resembling the structures which occur in *P. tabaninus*, and a pair of small blade-like organs which fit into a groove on the inner surface of these. Dufour in 1850 called the main pair maxillae, since they bear palpi and reserved the name mandible for the small inner structures, and in this he was followed by Lundbeck (1908) and Malloch (1915). Melin, however, in his fine work on the Swedish ASILIDAE reversed the names for the mandibles and maxillae, because, according to him, the palpi in question are not in the slightest degree attached to the mandibles but only to the skin itself. Such a conclusion is surprising for it is completely at variance with the accepted usage in other groups of the Brachycera, where the term maxilla is by general consent reserved for the outer pair of mouth-parts while the inner pair are termed mandibles. It would indeed be astonishing if the relative position of these appendages had become reversed in the ASILIDAE. Moreover, Melin makes no alternative suggestion as to what these palpi can represent if they are not maxillary, for from their position it seems very unlikely that they can belong

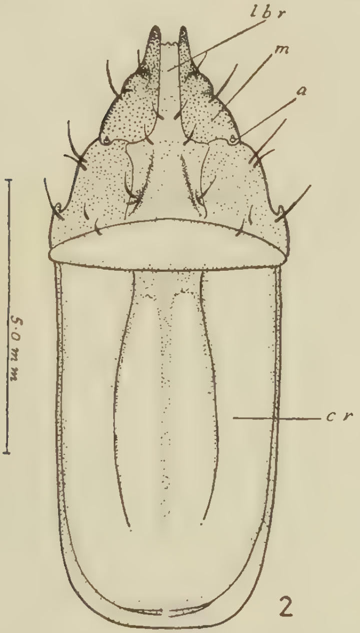

FIG. 2.—Head capsule of larva, dorsal view. a = antenna; lbr = labrum; m = maxilla; c r = capsule rod.

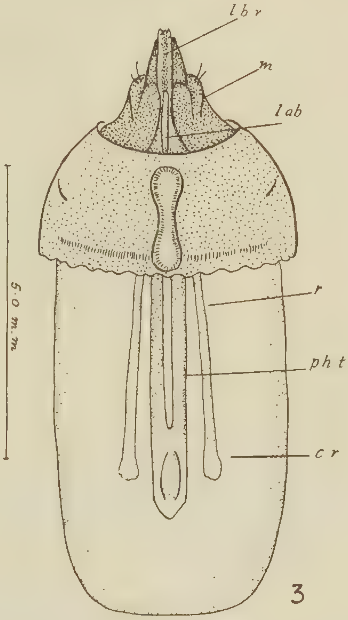

FIG. 3.—Head capsule of larva, ventral view. lab = labium; r = lateral rods from "pharynx support;" ph t = pharyngeal trough; other lettering as in fig. 2.

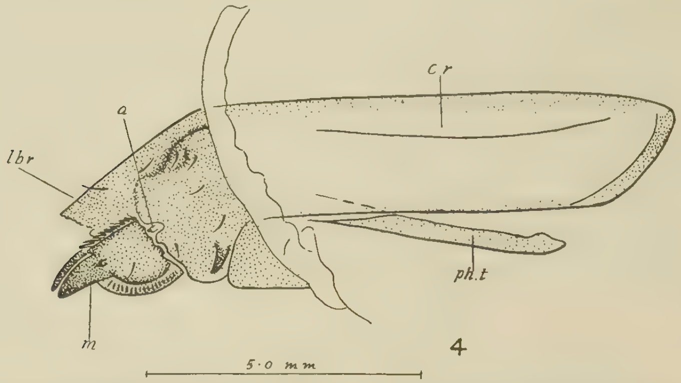

FIG. 4.—Head capsule of larva, lateral view. Lettering as figs. 2 and 3.

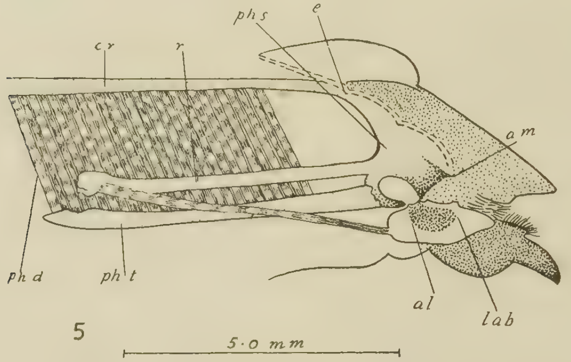

FIG. 5.—Head capsule of larva. Lateral view with right maxilla and part of head capsule dissected away to show articulation of labium and internal structure of head. a m = articulation of maxilla; a l = articulation of labium; e = cut edge of cuticle; ph s = median internal skeleton of head, called "pharynx support" by Melin; ph d = pharyngeal dilator muscles; other lettering as in figs. 2 and 3.

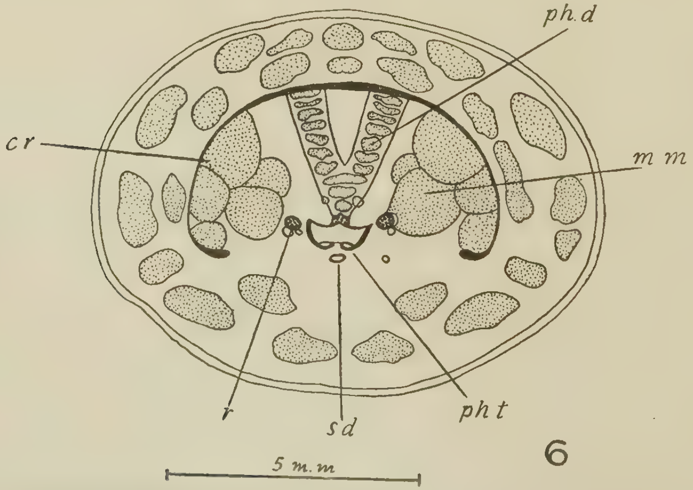

FIG. 6.—Diagrammatic transverse section through anterior region of prothorax of larva. m m = muscles of maxilla; s d = salivary duct; other lettering as figs. 2 and 3.

to the inner pair of mouth-parts. The fact that they are placed on a membranous area at the base of the big appendages and not on the appendages themselves cannot be considered a very convincing argument in larvae such as these, where the extent of sclerotisation varies so greatly from one genus to the next.

In *Pantophthalmus* the palpus is situated well forward on the sclerotised mouth-part itself just at the base of the large apical tooth. It therefore seems more reasonable to assume that the conspicuous mouth-parts in both the ASILIDAE and PANTOPHTHALMIDAE are the maxillae, and that the true mandibles in the latter group are either missing entirely or else are incorporated with the maxillae in the course of development. Not till opportunity offers to study the embryology of *Pantophthalmus* will it be possible to decide finally which appendages go to the making of these powerful jaws. Similarly, a re-investigation of the development and nerve supply of the smaller pair of structures found in the ASILIDAE will be necessary before it is possible to come to a final conclusion as to their homologies. Perhaps they may prove on further study to be of a purely secondary nature.

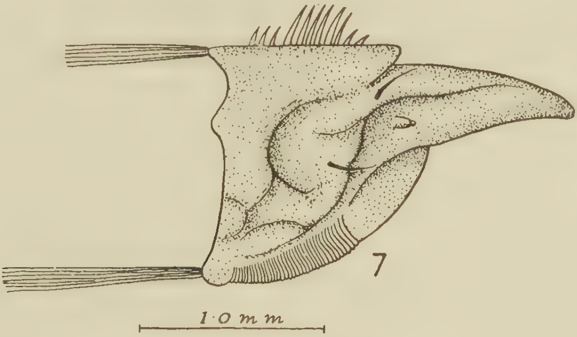

FIG. 7.—Right maxilla of larva, external view.

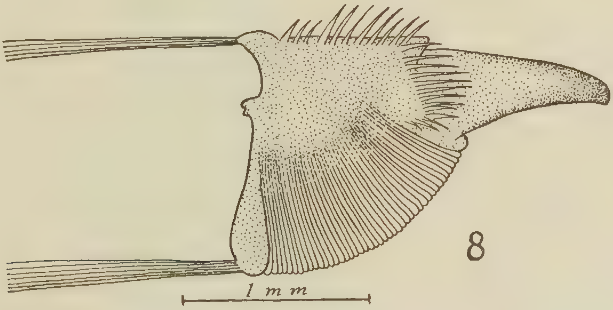

FIG. 8.—Left maxilla of larva, internal view.

The maxillae, then, of *Pantophthalmus* (figs. 7 and 8) move in the vertical plane and are articulated by two condyles, the external one impinging on the lateral wall of the head capsule just below the antenna, and the internal one articulating with a process situated on that part of the inward projection of the head capsule, called by Melin (1923) the "pharynx support." The movement of the maxillae is brought about by protractor and retractor muscles attached dorsally and ventrally to the base of the organ and running backward to attachments on the inside of the capsule rod and on a projection of the pharynx support. On the internal face the maxilla bears a row of stiff bristles which project above the dorsal margin and consequently are visible externally. The lower edge or flange, below the base of the tooth, is ribbed to form what appears to be a powerful grinding molar area, but from its position it seems doubtful whether it can be used as such.

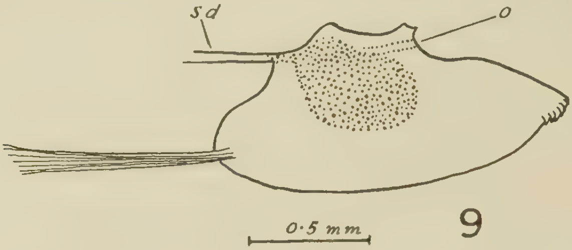

Fig. 9.—Labium of larva. s d = salivary duct; o = orifice of salivary duct.

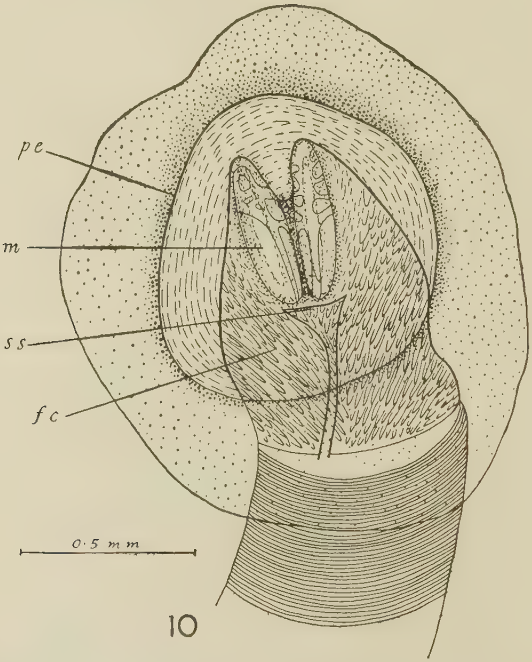

Fig. 10.—Anterior spiracle of larva. p e = peritreme; s s = stigmatic scar; f c = felt chamber; m = margin of true spiracular opening.

The labium can be seen in ventral view (fig. 3) as a narrow blunt projection lying between the maxillae. When one maxilla is removed it is seen to be a laterally flattened structure bearing the opening of the salivary duct just in front of a somewhat spoon-shaped sclerotised area. Just below the apex are some backwardly projecting teeth. The labium does not seem to be capable of much movement. It has a double articulation with the head capsule (see fig. 5), and there is a muscle which runs backwards and is attached to the lateral projections of the pharynx support.

The internal skeleton of the head is very similar to that described by Melin (1923) in the Asilidae. Dorsally it is prolonged backwards into the first thoracic segment in the form of a broad inverted trough, the "capsule rod" of Melin ("kopfplatte" of de Meijere, 1917) (figs. 2 4), this serves for the attachment of the dilator muscles of the pharynx and the big muscles of the maxillae. There is a median backward prolongation, ventral to the capsule rod, which may be termed the "pharynx support" ("Vertikalplatte" of de Meijere). Anteriorly it gives rise on either side to condyles for the articulation of the maxillae and labium. Posteriorly it is produced in the form of a narrow median trough which carries the pharynx and which reaches back nearly as far as the capsule rod itself; it also gives rise to two shorter and less strongly sclerotised rods ("Tentorialstab," de Meijere) (fig. 5) lying slightly above and on either side of the pharynx. These rods serve for the attachment of certain of the protractor muscles of the maxillae and also for the labial muscles.

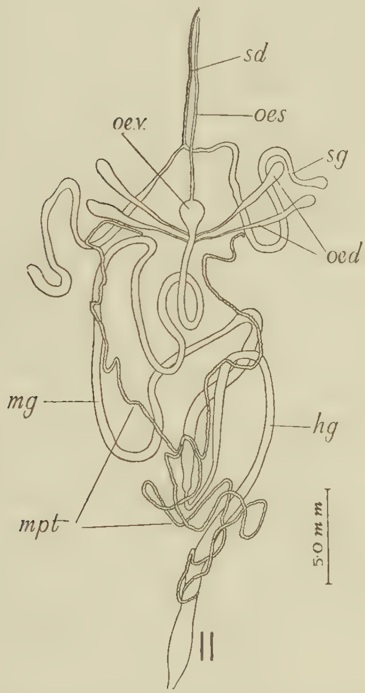

Fig. 11.—Alimentary canal of larva. s d = salivary duct; s g = salivary gland; m g = mid gut; h g = hind gut; oe d = oesophageal diverticula; oe v = oesophageal valve; mp t = malpighian tubules.

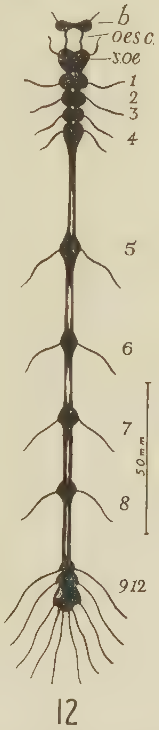

Fig. 12.—Nervous system of larva. b = supra-oesophageal ganglion; oes c = oesophageal commissures; s oe = sub-oesophageal ganglion; 1–3 = thoracic ganglia; 4–12 = abdominal ganglia.

The alimentary canal of the larva (fig. 11) does not require much comment.

Its length is about 2½ or 3 times that of the larva itself. A narrow oesophagus is followed by a pyriform oesophageal "valve." Behind this arise four gastric caeca. The mid gut takes two turns behind the point of attachment of the caeca and then lies in the form of a big loop reaching forward to the second post cephalic segment. A well-developed peritrophic membrane is present. The Malpighian tubules, four in number, arise in the region of the 7th segment. The long anterior ones of each side stretch forward as far as the caeca in segment 3. The posterior branches are short. Proximally the two tubes of each side run parallel for a short way and then apparently unite to form a very short common duct. They are covered by a close weft of tracheal branches in this region which makes dissection of preserved specimens very difficult. The two common ducts appear to be attached at the same point on one side of the alimentary canal, but I have been unable to determine whether their openings are separate or whether they unite as in the case of the STRATIOMYIDAE (Vaney, 1902).

There is a long narrow hind gut, which is looped in segments 7–10 and which then runs straight to the anus, which is situated on the 11th segment in between the two "finger-like organs." The hind gut is simple and does not show division into different regions. The total length of the alimentary canal is about three times that of the body.

The salivary glands are present in the form of simple whitish tubes lying coiled in the fat body on either side of the oesophagus in segments 2 and 3, but apparently not extending much further back. The common duct, which is long and shows an annular, taenidia-like lining, runs beneath the median prolongation of the pharynx support and opens on the labium (see figs. 6 and 9).

The tracheal system does not require much discussion as a description, and drawing is given by Fiebrig for *P. pictus*. The larva is amphipneustic, the conspicuous anterior spiracles (fig. 10) being situated on the prothorax, while the posterior pair are placed within a deep transverse cleft on the underside of the last segment and which can be opened or closed at will. The main longitudinal tracheal trunks run direct between the anterior and posterior spiracles; they have a diameter of 1·5 mm. There are anterior and posterior transverse commissures and the main trunks give rise to branches in each segment. Segments 3–10 show rudimentary spiracles. The most striking features of the tracheal system are, firstly, the dense tufts of fine branches which arise from a forwardly directed branch of the main trunk in the prothorax and which supply the great maxillary muscles; and, secondly, similar tufts springing from the main trunk close to the posterior spiracle and supplying the curious finger-like diverticula which lie on either side of the rectum.

The "finger-like organs" ("fingerförmigen Körper" of Fiebrig) form one of the most striking external features of the insect and have been the subject of speculation by both Engel (1924) and Fiebrig. Engel considers them as equivalent to the "blind tubes" of *Eristalis* larvae and as analogous to the rectal papillae of the adults; one function of which is, he considers, to remove the CO_2 from the blood into the rectal fluid. Fiebrig observed the extremely rich tracheal supply which is contained within these organs and which is easily seen in living specimens though invisible externally when preserved. He states that (in *P. pictus*) there is no real cavity in the individual fingers, nor was he able to detect muscles or nerve fibres. He discusses the possibility of their being of a glandular nature, but finally pronounces in favour of considering them as accessory respiratory organs which may come into play when the chamber containing the hind spiracles is closed and when the larva is submerged in the fermenting sap on which it feeds.

Observations on the living larva of *P. tabaninus* showed, as in *P. pictus*, a very rich tracheal supply ramifying throughout the finger-like organ, the tracheoles ending in the hypodermis. There is also, contrary to the statement of Fiebrig, a considerable cavity containing a good supply of blood. There is, however, no regular blood circulation although an ebb and flow of blood within the organ is brought about by the contractions of the posterior segments of the body. I was unable to find any muscles within the "fingers" and it does not seem as if they can be moved separately, although a certain amount of retraction and extension can be brought about by the movements of the body segment concerned. When the segment is fully expanded ventrally and slightly contracted dorsally so as to arch it somewhat, the gills stand away from the body wall a little and thus appear slightly extended.

Time and material were limited, but a few experiments were carried out on living larvae which may be briefly recounted here.

When a big larva is washed and placed in a solution of a suitable p_H indicator, in this case Cresol Red, the escape of CO_2 from the surface of the "fingers" is shown within 2–3 seconds by the change in the colour of the indicator towards the acid side. If the larva be held still in the fluid for 2–3 minutes the change becomes practically complete in this particular region and is also visible at the mouth of the spiracular cleft, but as yet nowhere else. Not till after 10 minutes in the indicator does any colour change appear at the rest of the body surface. This experiment was carried out eight times, always with the same result. It shows, of course, that gaseous exchange is taking place with very much greater speed at the surface of the tracheal gills than elsewhere and that under certain conditions the "finger-like organ" can indeed act quite effectively as a gill. Whether this is an important function under natural conditions is another matter and remains in doubt. The larva is active and can readily move to the top of the liquid in the burrow to renew its air supply; indeed, when excavating, it must frequently do so in order to eject the fibrous material which it has rasped off with its maxillae. Moreover, it seems improbable that the oxygen tension in the fermenting sap which accumulates at the bottom of the burrows can be very high. Also it was found that larvae could live for over 12 hours in freshly boiled water in a gas-tight container, although after about 8–10 hours they become immobile and the heart beat no longer visible. Larvae which were allowed to place their posterior spiracles in contact with the atmosphere during the course of the experiment remained unaffected.

Considering the high temperatures which prevail in the localities where the insect is found one might expect the development to be completed in much less than the time actually taken. Moreover, the explanation usually advanced for the slow development of wood-boring insects, namely the low nutritive value of the diet, may not apply in this case since the food is said to consist of the sap which flows abundantly. If, however, it is indeed a fact that the larvae are normally exposed to a very low oxygen tension, an explanation of the slow rate of growth is at hand. Such, it has been suggested, is the reason for the protracted growth period of *Gastrophilus* in the stomach of the horse.

Nervous System.

The central nervous system of the larva is remarkably unspecialised, although there is a slight shortening, as a consequence of which the terminal compound ganglion lies in the 7th post cephalic segment. A detailed description is unnecessary as the illustration (fig. 12) shows all the important points.

In the comparative absence of fusion between the ganglia the nervous system is very similar to that of the LEPTIDAE, XYLOPHAGIDAE, ASILIDAE and THEREVIDAE (Brauer). The fact that it is double throughout suggests particularly close affinity with *Leptis* since, as far as I am aware, this is the only other brachycerous larva in which this condition is known to obtain.

MORPHOLOGY OF THE ADULT.

In this section it is proposed to consider only those parts of the adult anatomy which might be expected to show some modification in connection with the peculiar mode of life, or which might prove useful in determining the true relationships of the family.

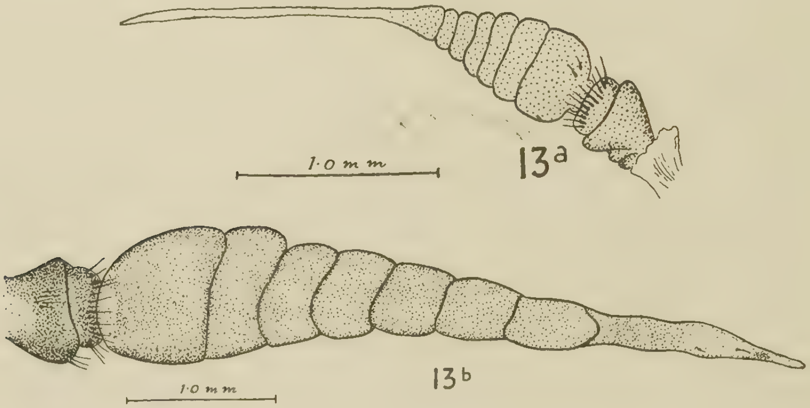

FIG. 13.—Antenna of adult. a—male; b—female.

Mouth-parts.

It is not certain whether the adult insects are capable of taking food. Urich states that he has failed to induce them to do so. The mouth-parts are completely developed, but the proboscis is extremely short and appears to be practically incapable of extension forward or downward. There are two large white labella which show on the lower half of their inner faces a series of pseudo-tracheae, which are kept open by rather faintly pigmented chitinous hoops. Muscles are present within the labella which doubtless can bring about their separation and extension laterally, and it is possible that they can be brought into play by lowering the head so as to bring them into contact with any exposed food substance such as an exudation of sap. A small theca is present and an imperfectly sclerotised furca with a curved lateral process to which muscles are attached can be seen on the outer side of the labella. Otherwise the proboscis itself is not sclerotised except for the common groove into which the pseudo-tracheae discharge and which is noticeably pigmented. There is a bilobed hypopharynx bearing the opening of the salivary duct on its median portion and a conspicuous grooved labrum epipharynx. In both sexes there is a pair of narrow blade-like maxillae, those of the male being broader and more lobed than the female (figs. 14 *a* and *b*). The blades, which probably represent the galeae, lie on each side of the proboscis entirely outside the oral groove. Attached to each maxilla is a relatively enormous palp. These also show striking sexual differences. A pair of apodemes run upwards superficially from the base of the labrum-epipharynx forming the margins of the genae. The fulcrum is elongate, bearing the pharynx on its floor and well-developed pharyngeal dilator muscles are present.

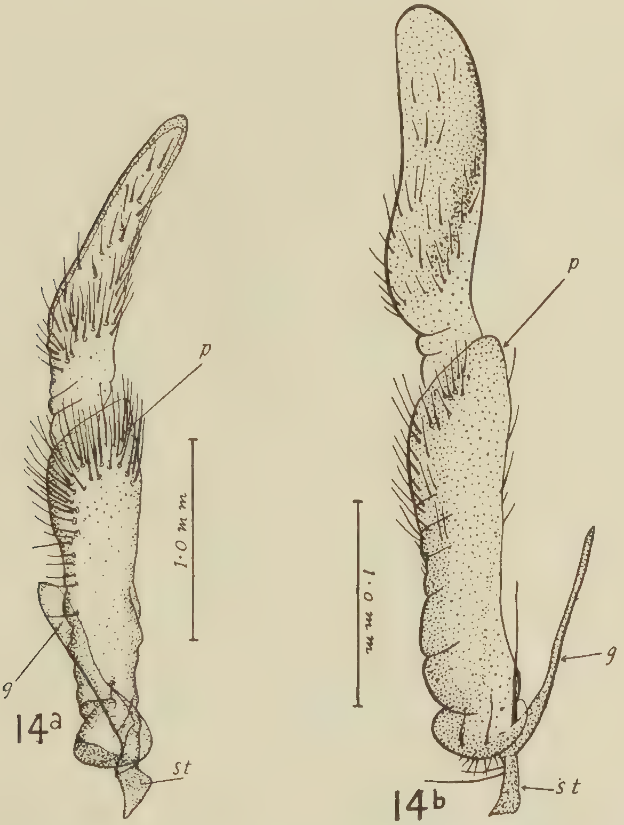

Fig. 14.—Maxilla of adult. a—male; b—female; st = stipes; g = galea; p = palp.

Internal Anatomy.

Contrary to what might be expected in the case of an insect which it is asserted takes no food, the alimentary canal is fully formed. The oesophagus is a simple tube which bends sharply downward after leaving the "fulcrum." It possesses a long food reservoir, the duct of which opens on the ventral side. A small proventriculus is present. The mid gut is thrown into a simple coil and is narrow throughout save where it gives rise to the four Malpighian tubes. The hind gut is narrow except for the rectum, which bears six conspicuous rectal papillae, as in the TABANIDAE.

The Malpighian tubes are inserted close together on one side of the gut as in the larva. The posterior pair are of the usual type, but the anterior ones are longer and considerably dilated. They lie coiled on either side of the gut in the region of the 2nd and 3rd abdominal segments. The dilation is more noticeable in some specimens than in others and is particularly obvious in the males.

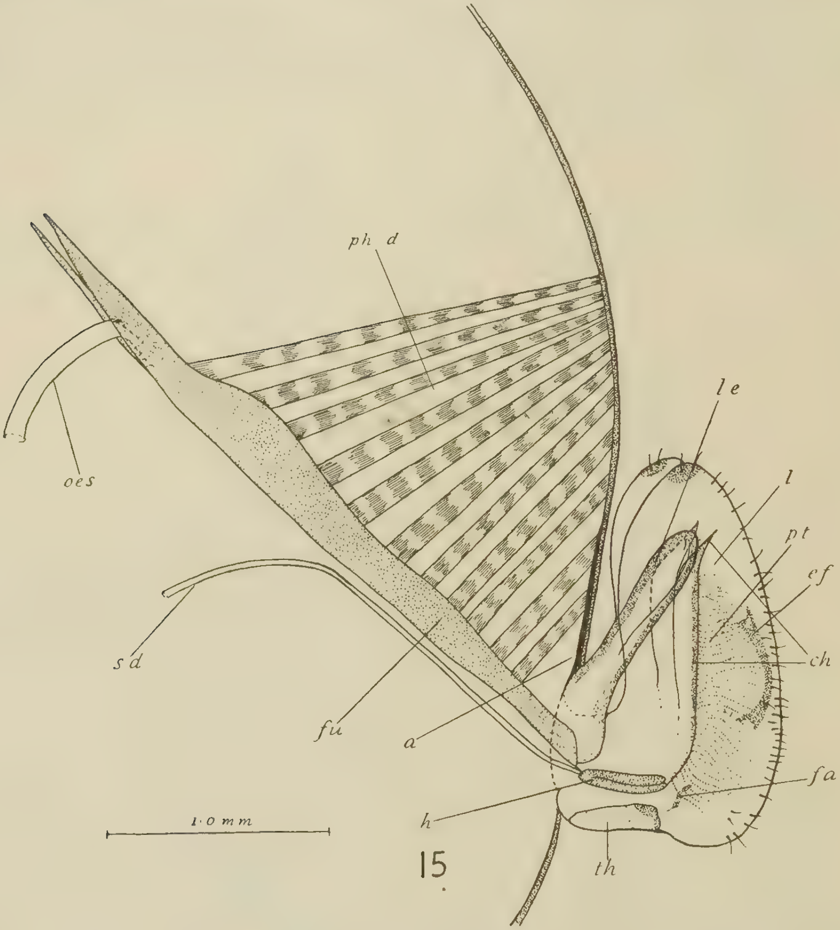

FIG. 15.—Adult mouth-parts, lateral view after clearing. l = labellum; l e = labrum epipharynx; a = apodeme; th = theca; fa = "furca"; pt = pseudotracheae, dotted lines indicate course of pseudotracheae on inner face of right labellum; ef = lateral process of furca; h = hypopharynx; fu = "fulcrum"; ph d = pharyngeal, dilator muscles; s d = salivary duct; oes = oesophagus; ch = common channel receiving pseudotracheae.

Salivary Glands.

The simple salivary glands are short and poorly developed. They lie below and on either side of the alimentary canal in the mesothorax. Their ducts run forward to the prothorax, where they unite.

The nervous system of the adult is shown in fig. 19. It resembles that of the larva somewhat in the absence of concentration and in the double nature of the nerve chord. The oesophageal commissures are very broad, leaving only a minute aperture for the passage of the alimentary canal. There is a large thoracic ganglion which sends large nerves to the wings, the halteres and the three pairs of legs. This is followed by five abdominal centres, the first of which lies within the thorax although its nerves supply the 1st abdominal segment.

Genitalia.

The male genitalia are shown in figs. 16 and 17. There has been a twisting of nearly 180° from left to right, partly between segments 7 and 8 and partly between 8 and 9. The effect of this twist is to produce a "hypopygium inversum" in which the genital opening is dorsal to the anus; a condition already known to exist in certain Asilidae (Laphriinae) and Bombyliidae as well as in many Nematocera.

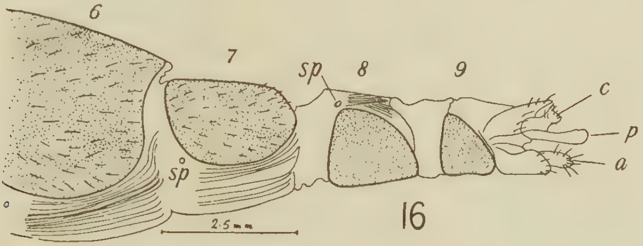

Fig. 16.—Adult, lateral view of extended post abdomen of male. sp = spiracle; p = penis; a = anus; c = clasper.

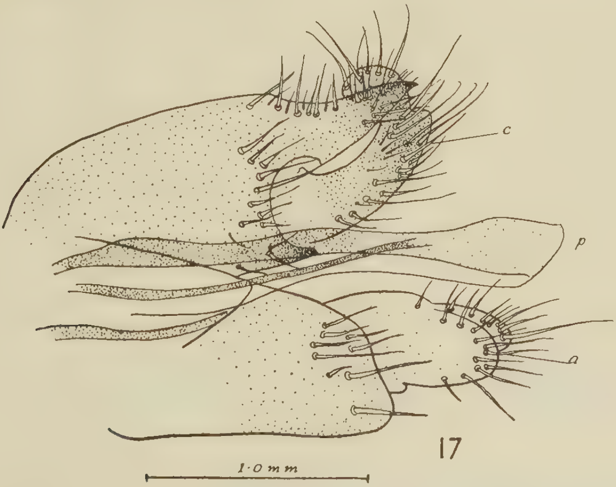

Fig. 17.—Lateral view of male genitalia. Lettering as fig. 16.

In the female the 8th and 9th segments are greatly elongate. The 9th segment can be bent downwards at a point about half-way along, thus enabling the ovipositor to be tucked back underneath the abdomen when at rest. The most striking feature of the female genital apparatus is an internal chitinous rod, in the shape of an elongate U, which is conspicuous in specimens which have been cleared. It reaches back about half the length of the 9th segment. One cannot be sure of its exact relationships without sectioning, but it appears to be concerned with the attachment of muscles which run to the walls of the segment. It is probably homologous with the " gabel " described by Reichardt (1929) in the Asilidae. In the Asilids this " gabel " is a fork-shaped apodeme the handle of which lies above the oviduct while the prongs are fused with the roof of the vagina. It serves as a framework to which the muscles that control the movement of the genitalia are attached.

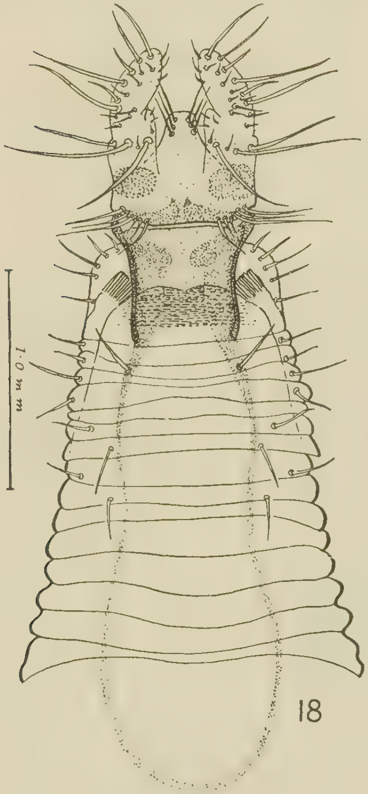

Fig. 18.—Female genitalia, dorsal view.

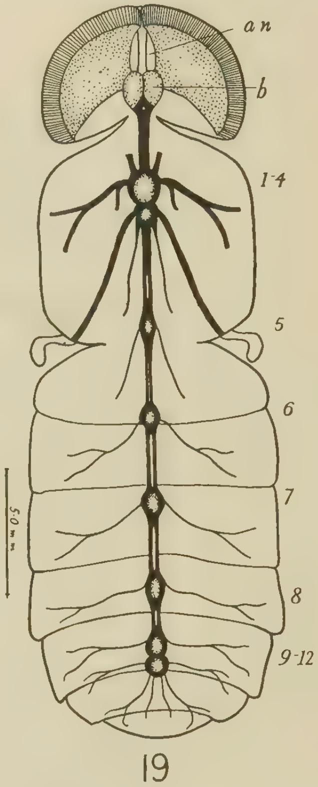

Fig. 19.—Nervous system of adult. b = brain; a n = antennary nerve; 1–4 = compound ganglion consisting of thorax 1–3 and abd 1; 5–12 = second to 9th abdominal ganglia.

Discussion.

From the foregoing account it will be seen that while the larva is strikingly modified in its external features for its life as a wood borer, there is little specialisation in the internal anatomy either of the larva or the adult.

Among the obviously adaptive features of the larva the great strength of the mouth-parts, the heavy sclerotisation of the head capsule and the development of the great posterior shield may be mentioned. More doubtful is the curious situation of the posterior spiracles in a ventral transverse slit. This might perhaps be interpreted as a protection for the spiracles when the larva is feeding beneath the surface of the sap although the anterior spiracles do not seem to need any such protection. More problematical still is the significance of the "finger-like" organ or tracheal gill apparatus. In the aquatic Leptid genus *Atherix*, protrusible blood gills of a very different type are present, but since neither the XYLOPHAGIDAE nor the COENOMYIDAE are aquatic in their early stages it seems likely that the structures found in *Pantophthalmus* were evolved as a response to life in sap-filled burrows. Yet although potentially effective organs it seems improbable that under natural conditions they can be of much value for respiration.

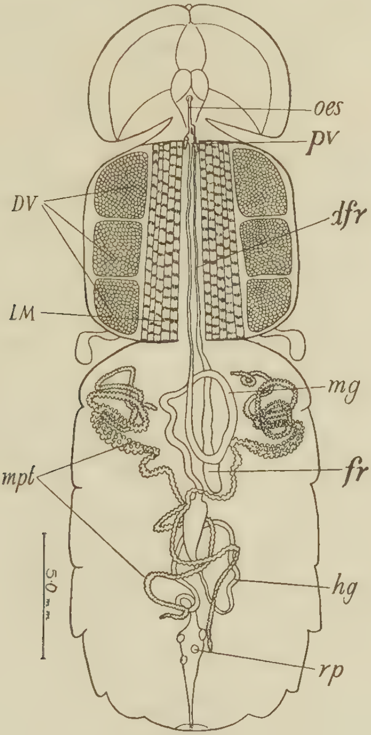

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FIG. 20.—Alimentary canal of adult. oes = oesophagus; f r = food reservoir; pv = proventriculus; d f r = duct of food reservoir; m g = mid gut; mp t = malpighian tubules; h g = hind gut; r p = rectal papillae; d v = dorso ventral thoracic muscles; l m = longitudinal thoracic muscles.

Both Fiebrig and Urich aver that the larva feeds solely upon the fermenting sap. De Andrade on the other hand states categorically, without giving his evidence, that it is xylophagous; from the nature of the mouth-parts however, it seems unlikely that the larva could ingest solid particles of any size. Certainly the fibrous debris which is such a conspicuous feature around the infested trunks has quite clearly not passed through the alimentary canal; it has merely been rasped off by the maxillae and ejected from the burrow by means of the posterior shield. The true faecal residue is a chalky-white semi-fluid substance. As would be expected, fungal spores of various types and what appear to be traces of fungal hyphae abound in the gut and these together with bacteria probably constitute the important source of nourishment. But in addition minute irregularly-shaped scraps of tissue are present in the gut contents, and these give a strong positive reaction to the Phloroglucinol microchemical test for lignin. It seems therefore that a very small proportion of the woody material destroyed is actually swallowed and perhaps digested.

In the adult the somewhat reduced condition of the proboscis is noteworthy in view of the statement that no food is taken during the perfect stage. Internally, however, the alimentary system of the adult is normal save for the much reduced salivary glands and the rather short mid gut.

The question remains; what light does the study of the internal anatomy of larva and adult throw upon the problem of the relationships of the PANTOPHTHALMIDAE? Does it support the general opinion, based on external characters, that there is a close affinity with the XYLOPHAGIDAE and COENOMYIDAE? Unfortunately, although something is known of the anatomy of the STRATIOMYIDAE, LEPTIDAE, TABANIDAE and ASILIDAE, there is very little on record as to the structure of the XYLOPHAGIDAE and COENOMYIDAE.

As has already been said, the larva is unique among Brachycera in regard to the peculiar type of tracheal gills which it carries. In the large size of the mouth-parts and to a certain extent in the structure of the head capsule there is a likeness to the larvae of the Asilid genus *Hyperechia* which live in the borings of Xylocopid bees (Thorpe, 1927), but these resemblances are superficial only. The absence of mandibles in *Pantophthalmus* distinguishes it at once from all other Brachycera. Brauer's figure of *Xylophagus* is rather obscure, but I have examined the mouth-parts of a Xylophagid larva, very probably *Xylophagus ater*, and have found both mandibles and maxillae present. They are also present in the STRATIOMYIDAE, although from my own observations on *Stratiomyia* sp. I believe that Brauer has applied the names incorrectly and that the conspicuous lateral structures are the maxillae, the strongly toothed mouth-parts lying between and below them being the mandibles.

In the LEPTIDAE (*sens. strict.*) both mandibles and maxillae are present (Brauer, 1883; Wheeler, 1930). Although larvae of the COENOMYIDAE have been described (Beling, 1880; Malloch, 1917) no account of the mouth-part structure is given, but through the kindness of Dr. H. Zerny I was able, while in Vienna this summer, to examine specimens of *Coenomyia ferruginea* in the collection of the Naturhistorisches Museum. In this species both mandibles and maxillae were found, the general arrangement being similar to that seen in *Xylophagus*.

The alimentary canal with its associated organs is fairly typical. The presence of the oesophageal diverticula differentiate it from *Tabanus* (Patton and Cragg, 1913; Stammer, 1924) and from *Vermileo* (Wheeler, 1930), while the asymmetrical insertion of the Malpighian tubules recalls *Stratiomyia* (Vaney, 1902). The situation of the posterior spiracles within a transverse cleft also recalls the STRATIOMYIDAE, but in *Pantophthalmus* this cleft is ventral whereas in the former it lies dorsally. The rudimentary lateral spiracles of *Pantophthalmus*, although they have been overlooked by all previous observers, are visible externally. The nervous system, as has been said, is definitely of the Nematoceran type, and is totally unlike that of any known Brachycerous larva.

The internal anatomy of the adult is very similar to that described for the TABANIDAE (*Haematopota*), but as in the larva the asymmetrical Malpighian tubules are a peculiar feature. As far as the degree of ganglionic concentration goes the nervous system is identical with that found in many TABANIDAE (Brauer). It differs from *Leptis* and *Xylophagus* only in regard to the number of ganglia represented by the terminal ganglionic mass, these two genera having six discrete post-thoracic ganglia. It shares with *Leptis* the peculiarity of retaining the double condition of the nerve chord throughout life.

To summarise, it can be said that while the larva shows certain decidedly primitive and peculiar features which separate it from the rest of the Brachycera, the adult is undoubtedly structurally very close to the Leptidae (including Xylophagidae and Coenomyidae). Owing to the present fragmentary state of our knowledge of these allied groups, a final conclusion as to the relationships of the family cannot yet be reached. Nevertheless one can say that the fresh evidence here brought forward tends to support the view that the Pantophthalmidae are most nearly related to the Leptidae (*sens. lat.*), but that they also display affinities with the Tabanidae and to a lesser extent with the Stratiomyidae.

Summary.

The life-history of this remarkable insect is briefly recounted. The larva is a wood borer feeding mainly on the fermenting sap which accumulates in its burrows. Only a very small proportion of the wood itself seems to be ingested.

The internal anatomy of both larva and adult is described, and the adaptive significance of the various features discussed. It is concluded that morphological specialisation is practically confined to external characters.

The larva is unique among the known Brachycera in the absence of true mandibles, the maxillae being enormously developed. The tracheal gills of the larva are undoubtedly functional as such under experimental conditions. Under natural conditions, however, their significance is somewhat doubtful.

Although the adult is said not to feed the alimentary canal is fully formed and in its gross structure shows no trace of the degeneration which would be expected if this was indeed the case. Pharyngeal dilator muscles are present. The proboscis is formed from the labium, labrum-epipharynx and hypopharynx, but the whole structure is very short and does not appear capable of extension. Nevertheless it may possibly be of use for feeding on exposed liquid or semi-liquid food such as sap exudations. Maxillae are present lying on either side of the proboscis itself.

It is concluded that the family Pantophthalmidae is most nearly related to the Leptidae (especially *Xylophagus*), although the larvae exhibit certain peculiar features which distinguish them from all other known Brachycera.

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[R]

TWO COLLEMBOLA-COLLECTING CRABONIDS IN TRINIDAD

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[Read 6th December, 1933.]

With Four Text-figures.

In 1907 Ducke described the little Sphegid, *Microstigmus theridii*, and wrote, " J'ai trouvé cette espèce uniquement dans les nids d'un Araignée de la famille des Théridiées, dont la guêpe doit être le parasite. J'ai observé cinq de ces nids à Teffé et un à Santo Antonio do Içа; tous contenaient plusieurs femelles de *Microstigmus.* D'abord, j'avais pensé que les nids devaient être construits par la guêpe même, mais M. le Professeur Dr. Goeldi, les a reconnus comme étant le travail d'une Théridée."

Ducke's first estimate was correct, for three nests, which occur plentifully in Trinidad, suspended from the undersides of the huge leaves of *Coccoloba pubescens*, are undoubtedly built by the Sphegid itself. They do certainly, though very superficially, resemble the egg-cocoons of some of the Theridiid spiders, which are often suspended by a long pedicel in a similar manner; but it suffices merely to handle one to distinguish it.

The present study was written several years ago and put aside to await further investigation; but it seems better to put the data on record without waiting further.

On the 8th December in company with Mr. Urich I collected a number of these nests along the main road near Sangre Grande, on the well-known " Long Stretch," which passes through uninterrupted forest. The nests were found only beneath the huge rounded leaves—a foot across—of *Coccoloba pubescens*, and these, in the rain which was falling at the time, formed perfect umbrellas. The plants varied in height from 18 inches to 15 feet or more, and thus were mostly young. Most of our nests were on bushes about 8 feet high, and usually under fine, uninjured leaves which offered horizontal shelter. The procedure was to place a glass-bottomed pill-box at once over the whole nest. Often the little wasp dashed rather quickly out of the opening, near the stalk of the nest, and was thus secured.

We found altogether eleven nests—not more than one on each plant. Ten were brought home. Of these, two contained no living adults, three yielded one *Microstigmus* (female) each, one had two *Microstigmus* (both females), while four contained each an adult Chalcidoid parasite, and no owner wasps.

The first nest examined was of medium size and may be taken as a sample. The total length of the nest itself was 12 millimetres, with a coiled, rather thin pedicel reaching to the same length, but considerably longer if straightened. The shape was conical or irregularly pyramidal, with a beautifully neat circular opening strongly edged and placed at the apex, just beside the attachment of the pedicel. There were two distinct pockets in the floor, one quite empty, the other containing a small compact greenish mass which was dissected out to show the very fresh and moist remains of at least thirteen small Entomobryid Collembola, looking like several stages of the same species. In this case, no egg or larva of the wasp was found.

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The nest material.—The bulk of the rather diaphanous walls consisted of the shining red fibres from the young shoot and backs of midribs of the *Coccoloba.* These were not woven, as at first thought, but held loosely together by fine strands of what appeared to be delicate white silk. This silk became more plentiful towards the apex, making a stronger fabric, and wholly predominated in the pedicel, which looked whitish in consequence. The main walls were weak and easy to tear. The pockets were lined with the silk, more strongly, and the food wad and egg were moored securely to the walls by strands of the same material in all directions.

One nest, when found, had fallen from its leaf on to the one below, which was rather wet, and had stuck there. The wasp was at home.

The second nest examined was somewhat larger than the first, with two adults, and a wide flat floor containing only one pocket, in which was a larger compact mass of Collembola, with a white egg fastened to its side and curving round out of sight.

The third nest had accompanying it a parasite only. Its upper part seemed more strengthened than usual with silk and thus looked whiter in that portion. It was rather flattened from side to side, and the floor thus considerably longer than wide, with a pocket at each end. Each contained one white parasite larva, one nearly twice as large as the other; but both with a very tiny black pellet, apparently food remains, still adhering to its head. The larva lay in a kind of hammock of silk threads, nowhere touching the sides or bottom of the pouch.

The fourth nest likewise contained two pockets, but with only a slight blackish discoloration and dust, which may have been food residue, and one dried-up and dead larva, apparently full fed. No adults were present.

The fifth nest had one finished pocket and another corner that looked as though it should contain one, but was blocked with an irregular mass of fibre, which might perhaps later have been fashioned into a pouch. It was entirely empty.

The sixth example was obviously in course of building, and one owner wasp was present. There were two pockets, one already silk-lined, the other not, and a circular opening *in the floor*, not so neat as the final one at apex, and not strengthened with silk.

A male and a female adult Pteromalid parasite (indet.) were in the seventh nest, which was supplied with three pouches, two of them containing a small pellet of black, hard residue and the third a larger mouldy mass, apparently the remains of a whole provision packet occupying nearly the whole space.

The eighth nest, with two pockets, one empty and the other holding a little black dust, was old and dusty-looking. It was sheltering one adult parasite.

More interesting results were yielded by the ninth nest, which was taken to pieces on the 12th December. One adult parasite, a male, was present. There were two pouches, one containing a tiny black residual pellet and a healthy looking white *Microstigmus* pupa, slung in a silken network so that it nowhere touched the walls. From this pupa, on the 9th emerged a single minute Chalcidoid which failed to develop properly. It represented a third species in this interesting complex—a direct internal parasite of the host wasp.

The second pouch contained a similar black residual pellet, and attached thereto by its tail, quite unsupported by silken threads, a white pupa of the first-found Pteromalid parasite. From this an adult emerged on the 19th.

The last nest of the ten, accompanied by one *Microstigmus* adult, was remarkable in possessing four pouches, arranged irregularly round a pinched-up area of the floor. These pockets were not very thickly lined with silk, and were empty.

On 9th December, the examination of three nests from St. Anne's (Mr. Urich) near Port-of-Spain, yielded additional data. They were of stronger texture than the Sangre Grande material, with more silk in the walls, and stiffer pedicels, supplied at the top, at least in one case, with a beautiful white silken hold-fast, in the shape of a cross, two arms of which ran along a vein of the *Coccoloba* leaf, while the other two went at right angles to the line thus formed.

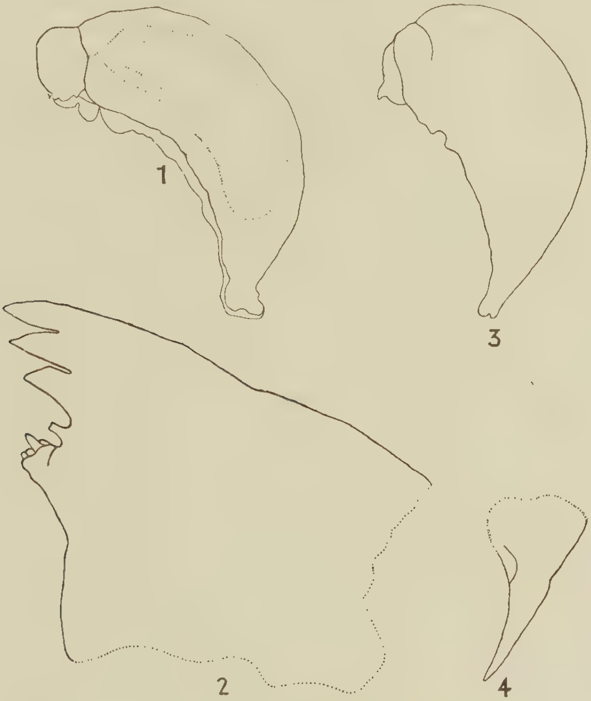

Fig. 1.—*Microstigmus theridii*, Ducke, full-fed larva.
Fig. 2.—*Microstigmus theridii*, mandible.
Fig. 3.—Sphegigasterine (Chalc., Pteromalidae) parasite, full-fed larva.
Fig. 4.—Sphegigasterine, mandible of penultimate instar larva.

The last nest, which contained two female *Microstigmus*, was very large and furnished with no fewer than seven pockets in a circle and an eighth within the circle, placed excentrically. During examination a freshly-emerged adult (a third) crawled out of one of the pockets, and climbed, all soft, with milky wings, up my finger, voiding a small meconium as it did so.

The first, sixth and seventh pouches contained a *Microstigmus* pupa head down in its hammock, and nearly ready to emerge, the second had a pre-pupa, the third and fifth were empty, the fourth showed a half-grown larva, lying on the food-mass, while the eighth, situated near the centre, and not in the circle with the others, held a very fresh food-mass, not yet supplied with an egg. Three adults emerged from this nest, one on the 18th and the last on the 24th December.

A food-package from another nest, dissected out, contained about 30 small Entomobryid Collembola, of perhaps one species, but varying ages. The limbs and antennae seemed to have been largely trimmed off before the insects were jammed together into a tight mass. From further material collected near Sangre Grande on 27th January, a single small Sminthurid was found among the usual Entomobryids stored.

On the latter date, a two-pouched nest yielded an adult female and a pre-pupa, which wriggled when disturbed. A nest with six pouches had two males, a female, two young larvae on their food-masses, one full-fed larva and three pupae at three distinct stages of development.

Many interesting questions suggest themselves for further study. What is the relationship of the two or three females sometimes found together in a single nest? It seems probable that the nest is gradually built by one female, a pouch at a time, and provisioned. This would account for the many different instars together in one nest; and the additional females may be merely freshly-emerged offspring waiting to go out and build nests of their own. On the other hand there remains the extremely interesting possibility that they may remain and build or renovate pouches of their own in the parent nest. The Pteromalid, so plentiful in the Sangre Grande nests, but not yet found elsewhere, possibly devours the egg or young and in its later larval stages becomes a food parasite. In this connection it is to be noted that the parent wasp does not close up the mouth of a pocket after provisioning it.

While *Microstigmus theridii*, at least in a fresh state, is a very pallid, yellowish-white little insect, with green eyes and black ocelli and stigma, a new species discovered in Trinidad is practically black, though similar in form. While *M. theridii* prefers to nest under the leaves of young *Coccoloba pubescens* plants growing on the edge of the forest, this black species, which has been named *M. myersi* by Dr. Ferrière, frequents the interior of the bush. Its small pouched nest, suspended by a long fine rootlet (?) and strongly resembling in general appearance, size and structure that of *M. theridii*, occurs under banks, among the numerous irregular concretions deposited by dripping water and dependent from similar rootlets. Some of this earth is incorporated in the walls of the nest, the source of the plant fibre for which is unknown.

A nest found in such a situation, near the Maracas Falls on 1st January, contained two adults which escaped before their sex could be ascertained, and one dark-coloured pupa, which duly produced an imago.

To Mr. Urich is due the credit for the discovery of the Collembolla-storing habit. I am indebted to Dr. Ferrière for naming the wasps and parasites themselves, and to Miss E. Fraser for the drawings of the larvae.

CONTRIBUTIONS TO A KNOWLEDGE OF S. AFRICAN MARINE CLUNIONINE-CHIRONOMIDS

By A. J. Hesse, B.Sc., Ph.D.

[Read 6th December, 1933.]

With Four Text-figures.

(A) The Early Stages and Ecology of *Telmatogeton sancti-pauli* Schin. (=*Trissoclunio fuscipennis* Kieff.) from the Cape Coast.

Kieffer described two species of marine Chironomids from the coast at Mouille Point, on the Atlantic side, in 1914, *Ann. S. Afr. Mus.*, **10** : 259–261, as *Paraclunio fuscipennis* and *P. minor*. Subsequently in 1920, *Ann. S. Afr. Mus.*, **17** : 523–525, he erected a new genus, *Trissoclunio*, to contain these two forms. In 1928, *Konowia*, **7** : 236, and 1928, *Proc. ent. Soc. Lond.*, **3** : 36, Edwards, who examined a specimen from the original material and who also had specimens of Schiner's species *T. sancti-pauli* before him for comparison, established *T. fuscipennis* Kieff. as a synonym of *T. sancti-pauli* Schin., which species was originally described in 1868 by Schiner from the Island of St. Paul in the Indian Ocean. The two species of the genus known in Hawaii are distinct from *sancti-pauli* and breed in streams.

As the late Dr. Peringuey collected *fuscipennis* on the Atlantic side at Mouille Point in the Cape Peninsula, an examination of the seaweed on the rocks and in pools along this shore was undertaken during August in the hope of discovering the early stages of this species. A careful inspection of the seaweed growing in rock pools was negative in results, but an examination of the seaweeds belonging to the genus *Porphyra* (Rhodophyceae) growing and thriving on exposed rocks at the higher levels between the tide marks, where the rocks are not entirely submerged during high tide, revealed the presence of Chironomid larvae. Among this collection there were some advanced pupae, empty pupal cases and larvae in different stages of development. A comparison of the imago within the pupal case and specimens which subsequently hatched in the Museum, with dried material of Kieffer's species in our collections, proved beyond doubt that these larvae and pupae were those of *T. sancti-pauli* Schin. (=*Trissoclunio fuscipennis* Kieff.). A subsequent visit to St. James in the Indian Ocean, revealed the presence of the same larvae also feeding on species of *Porphyra*. I am thus in a position to describe the larva and pupa and to add some ecological notes on the larvae of this interesting marine Chironomid, the early stages of which I believe have not been described before or at least to which I can find no reference in literature at my disposal.*

The Larva (fig. 1).

Length of mature larva from 8–10 mm.

Body usually pale greyish-olive, dull olive-green to darkish or brownish olive-green, the colour depending more or less on that of the weed, with the posterior pseudopodal

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* Reference should be made to the account of the early stages of the closely allied North American genus *Paraclunio* given by L. G. Saunders, 1928, Ann. ent. Soc. Amer., **21** : 521–545.

region and often the ventral region slightly paler and more greenish-white, with the cuticle often showing faint prismatic colours and a slight silvery sheen in certain lights when examined under magnification; head pale chitinous yellowish-brown to brownish and even dark brownish, the mouth-parts and sclerites being darker brownish, with the basal rim below of the cephalic capsule and the eye-spot black, the apical parts of the mandibles and the apical half of the mentum dark blackish-brown to black; hook-like spines on posterior pseudopods also black. *Head* oval, subcylindrical, shown in profile and enlarged from a ventral aspect in text-figure, with the slender bristly hairs disposed as in figure; eye-spot distinct, just behind basal part of mouth-parts and nearer anterior end; clypeal or frontal region usually with a central darker band, with two bristly hairs on each side as shown, with the clypeal part reinforced by a plate-like sclerite on each side, the rounded labral anterior part more membranous and provided with a brush of very fine hair; mandibles shown in position and also separately and enlarged, with about four teeth along outer lower margin in addition to the dentate apex; maxillary lobe or plates on outside and in front of mandibles more membranous, bearing a setiferous palp and some short bristly hairs towards their pointed apices and also basally; mentum shaped as shown in enlarged view to the left, not entirely flat but broadly U-shaped, with the apex sharp and pointed and about four or five teeth on each side; antennae short; ventral basal margin of cephalic capsule broadly emarginate to contain neck region below, its rim prominent and darkly chitinised. *Thorax* with the three segments as shown in figure and with the minute bristly hairs disposed as in figure and with a pair of lateral slightly longer ones on each side at about the middle having a common base; anterior segment the longest, more powerful,

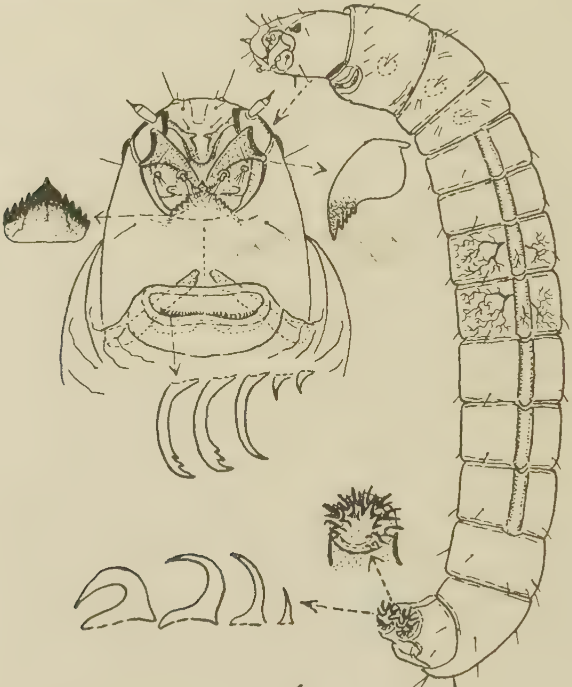

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Fig. 1.—Larva of *Telmatogeton sancti-pauli* Schin (= *T. fuscipennis* Kieff.), lateral view, the head and mouth-parts enlarged from below, the mandibles, mentum, anterior pocket with its enlarged spines and enlarged pseudopodal spines.

slightly overhanging the head and into which the basal part of head can be partially withdrawn, with a distinct small throat-region anteriorly below, behind it anteriorly on sternal region a distinct pocket-like protrusible and retractile sack, the rims of which are slightly tumid and the inside of which is lined posteriorly on each side with rows of differently shaped hooks or spines (shown enlarged), the anterior or front ones (those at bottom of pocket when retracted) being longer, more powerful and often provided with two subsidiary teeth towards their apices, with the hindmost ones towards rim very minute, not otenate apically and giving the posterior side and rim of pocket a densely shagreened appearance. *Abdomen* with segments 1–7 with a prominent and conspicuous ridge-like fold or lateral membrane on each side, with the rows of very minute and inconspicuous hairs arranged as shown in figure; segment 9 shaped as shown in text-figure, its dorsal posterior margin slightly overhanging pseudopodal segment and having, in addition to the other minute hairs, a pair of longer and more bristly ones arising from a common base on each side posteriorly; pseudopodal segment with a protrusible and retractile pseudopod on each side of the anal opening, their bases being broader than the narrower apical part, with the planta flat and circular when extruded, the crown of hooks more or less arranged in a biserial penellipse or often almost triserially, leaving a gap free from hooks posteriorly, the outer or front row of hooks larger, more bent and hook-like as shown separately to the left in the row of enlarged hooks, with the inner or second alternating row composed of longer, fewer and more claw-like ones and with the extreme ones on the sides from gap and often interposed ones, also on the sides, small, dentate and placoid. The most careful examination has revealed no spiracles, respiratory papillae or gill-filaments on any part of the body and respiration is apparently effected directly through the cuticle. Under a fairly powerful magnification branches from the lateral tracheal tube under the lateral fold on each side of the body may be seen to pass directly to the cuticle dorsally and ventrally (as shown on segments 6 and 7 in text-figure) where they subdivide into numerous small and almost invisible branchlets just under or in the cuticular covering, which thus in certain reflected lights appears to have a delicate silvery bloom or silvery down.

The Pupa (fig. 2).

Length about 8–9·5 mm.

Thorax above, metanotum and mesosternal region dark brownish-olive, with the convex discal part above darker, even blackish-brown; spiracular lobes pale yellowish-white, the spiracular opening being black; anterior cephalic lobes yellowish-brown; head below and anterior coxal region dull pale yellowish-white to yellowish; wings showing through dull dark brownish-olive or dark smoky-grey; legs pallid or whitish; abdomen showing through dull darkish-olive green above and below, the tergal quadrangular patches above darker than those below and the sides of these patches darker still, with the lateral parts showing through yellowish-olive, with the ∩-shaped basal chitinous lines bounding tergites and sternites anteriorly on pupal skin brown, the transverse basal shagreened bands and the two posterior shagreened patches on each side on tergites and sternites 3–6 very pale yellowish-brown; terminal segment with the oblique shield pale chitinous brownish-yellow, the upper overhanging arch-like part, its otenate spines and the dentate spines /c along edges of shield darker brownish to dark reddish-brown and the tuft-like hairs along edges of shield pale yellowish. The empty pupal skin with the thoracic region and terminal abdominal shield pale yellowish-brown, the wing and leg cases slightly paler, the basal ∩-shaped chitinous lines on tergites and sternites on abdomen as well as edges and spines of terminal shield more reddish-brown; spiracular lobes, pectoral and abdominal cuticle parchment-like or papery whitish.

Body shaped as shown in text-figure, dorsal and lateral views. *Head* almost ventral, closely adherent to thorax, produced above in front into two rounded lobes, each with a black bristle above basally; antennal cases visible on each side and already jointed, directed backwards over eye; head below with the frontal and clypeal parts as well as sheaths of mouth-parts of adult distinct, frontal part slightly transversely wrinkled; eye with a short black bristle on lower outer aspect and another longer one more inwards on posterior ridge bounding eye. *Thorax* with the disc subglobularly convex, sloping almost perpendicularly towards head, almost horizontal towards metanotum, transversely rugose and roughened towards head, more distinctly transversely wrinkled discally and the metanotum almost smooth, with a tubercular prominence on each side at about middle and some black bristles disposed as shown in figures; spiracular lobes (fig. 2 on right) in form of a prominently raised and conspicuous, compressed, chitinous, elongated lobe on each side, the apical part of which is narrowed to a blunt point resting against cephalic lobe, the broader basal part being fused to thorax, with the outer half near outer margin slightly transversely and irregularly septate, the spiracular opening itself slightly oblique and slit-like, but the atrium of tracheae broader than the spiracle and visible through the cuticle; sides of thorax behind spiracular lobes projecting outwards shelf or ridge-like; scutellar region not distinctly defined on pupal case; haltere rudiments in form of a tubercular prominence on each side of metanotum; wing-cases flexed under body as usual and covering the hind legs and already showing the main longitudinal veins. *Abdomen* with seven distinct segments and a terminal shield-shaped segment; tergites and sternites 2–7 each with a transverse ∩-shaped strongly chitinised reddish-brown line at base, the lateral limbs of which extend to near posterior part of segments, each tergite and sternite also with a transverse basal shagreened band composed of minute denticles just behind the basal

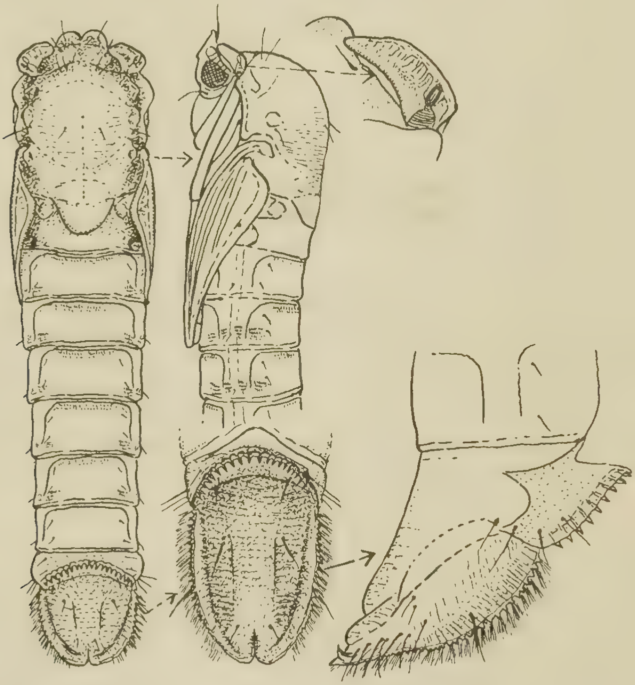

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Fig. 2.—Pupa of *T. sancti-pauli* Schin. from above and side, with an enlarged spiracular lobe and terminal shield.

chitinous lines, slightly coarser medially and also more distinct and narrower on the tergites, almost wanting or invisible on tergites 2 and 7, each tergite laterally also with a minute and inconspicuous black hair near base and one towards apex on each side; tergite 1 with a bluntly pointed lobe-like prominence laterally on each side; tergites and sternites 3-6 on each side posteriorly with an upper and a lower shagreened patch on each side of the chitinous line, composed of rows of minute yellowish denticles, the upper patch on tergites and lower on sternites respectively being broader, larger and more transverse, the other pair being separated by the lateral fold more ovate and smaller; lateral membrane also with a row of segmental minute black hairs; terminal segment (fig. 2 from behind and in profile) remarkably modified in the form of a broad elliptical, obliquely sloping, flattened shield, slightly smaller and often more ovoid in ♂, the rims or edges of which in both sexes are raised and dentate, the upper hood or arch-like edge slightly overhanging the shield proper, arcuately separated from it by an arcuate line and with a corrugated edge and stronger dentate spines, with the dorsum of this overhanging part more chitinous than the other abdominal tergites and black bristles disposed as shown in figures, with the shield proper more elongate and narrowed apically, its sides being almost subparallel to beyond middle in ♀, slightly shorter and often distinctly more ovately rounded in ♂, bilobate apically in both sexes, its surface regulose or slightly roughened, transversely wrinkled or striate and with the medial part slightly more raised and bounded on each side by a smooth impressed line, not reaching the base or apex, with the bristly hairs disposed as in figure, with the raised edges of shield jagged or dentate and provided with tufts of yellowish hair opposite each tooth or prominence; ventral part with a medial raised ridge-like sheath to beyond middle and a shorter apical raised sheath on each side in ♀ (these being the sheaths lodging the terminal pointed sternite and laminae of the adult), with the hypopygium of ♂ represented as a large pair of ventral contiguous elongated sausage-like or tumid sheaths, with the ventral black bristles in ♀ as shown in figure but in ♂ with an extra pair on each side where bases of clasper-sheaths are demarcated from a less chitinised basal part below and with fewer bristles on each side towards apex, with a distinct recurved hook-like dentate spine in both sexes on each side below on terminal lobes of shield in line with the row of black bristles.

Ecological Notes on the Larvae and Pupae.

The larvae of this species of *Telmatogeton* are remarkable in that they definitely live and feed on seaweeds belonging to the Bangiaceae (Rhodophyceae), namely *Porphyra capensis* Kütz, and *P. vulgaris* Ag., the former of which is very common on exposed rocks on the shore between high and low tides at Mouille Point on the Atlantic Ocean, and the other which is not very common on rocks at the higher levels at St. James in the Indian Ocean. These plants are attached to rocks which are only partially submerged once in twelve hours and the larvae are more common on those plants which are usually not permanently submerged during high tide, but which are nevertheless drenched or washed over by successive waves. As a matter of fact more larvae were found on those plants which become partially wilted or even dried out during the hottest period of the forenoon and noon. The wilted seaweed becomes almost papery, lying flat against or adhering to the rough rock-surface. It is when such weed is peeled away from the surfaces that larvae are found among the folded fronds and especially towards the base or attached ends where by far the greatest number of them are to be seen and where the plants still retain some considerable amount of moisture. The larvae have not been found on weeds permanently submerged in rock pools or at the low tide level and they are thus not definitely aquatic in the sense that other marine Chironomid larvae are. They, however, apparently never actively expose themselves directly to sunlight or external climatic conditions, always crawling and keeping under cover of the weed. Entirely free specimens under the broad fronds of the plants are by no means common at Mouille Point, but on the less foliaceous *P. vulgaris* at St. James they are more often found crawling about freely among the fixed ends. The almost mature or full-grown larvae usually utilise the natural tunnel-like folds in the fronds, the open sides of which they partially bind together by means of threads of a viscous exudation or secretion issuing from the mouth. The entire body is not always enclosed but only the posterior three-quarters or more in which tunnel the posterior pseudopods are firmly fixed to the plant. That the larva is capable of leaving this tunnel for a new feeding position or after high tide is evidenced by the presence of previously occupied and now empty tunnels, the surface of the plant in front of which is often eaten away. Owing to the narrower and less dense *P. vulgaris* at St. James and often also at Mouille Point, the larvae, in addition to utilising folds in the broader fronds, also become attached to the bare rocks or boulders in some crevice or depression, where they seal themselves up in often irregular tunnels the outer walls of which are composed of this thready or viscous secretion. The making of a temporary tunnel appears to be a necessary procedure during very low tide when the rocks and boulders become dry or warmed up by the sun and the *Porphyra* becomes partially wilted. As the larvae have no external spiracles or gill-filaments and respiration is effected through the cuticle, a certain amount of humidity and moisture is essential and this is suitably maintained by an almost impervious viscid or silky envelope on the rock surface or in a partially closed but moist tunnel within the folds of the seaweed. Apparently the larvae leave these " makeshift " tunnels to feed during the semi-submerged or drenching period of the high tide and even continue to feed long after the ebb when the weeds are still very wet, enveloping themselves again as soon as the noonday heat or periods of maximum dessication set in. It is also apparent that the maximum freedom of the larvae and the periods of active feeding are maintained during favourable environmental periods, such as during the night, foggy or rainy days and during cold and moist spells. The larvae also appear to be highly adaptable to the varying climatic and physical conditions to which they are subjected. The rocks on the Atlantic side at Mouille Point and Three Anchor Bay are composed mostly of outcrops of the Malmesbury Slates, which, under marine and littoral denudation, become jagged, rough and porous. It is on the higher outcrops, between the tide marks, that the species *Porphyra capensis*, with broader, more foliate and darker green fronds, mostly flourishes. Under such conditions the larvae rarely move about freely among the plants, are darker green in colour and hardly ever enclose themselves on the rock surfaces. On the other hand at St. James in the Indian Ocean, the rocks on the shore are composed entirely of blocks and boulders or even flattened masses of the Cape Sandstone, which under marine conditions weathers away as rounded, smooth and cracked masses. The lower levels are invaded by numerous kinds of other seaweed and only a few outcrops along the higher levels support a very sparse growth of *Porphyra vulgaris*, which is much paler and more greyish olive-green in colour and also more shready and less foliaceous. Under these conditions the larvae apparently have less opportunity of utilising broad fronds and merely attach themselves to the bare rock on which the plants are attached and also show a colour harmony. The larvae, under both conditions, are also perfectly adapted to the inclement conditions on these coasts, such as violent winds, periodic drenchings, occasional submergence by breakers, high temperatures during sunny days and very cold, murky and foggy conditions of winter weather. The comparatively strong cuticular covering is resistant to the physical and physiological effects of such extreme conditions. The existence in a tunnel within the fronds and the attachment of the pseudopods obviate the possibility of being forcibly removed or washed away from the plants which are buffeted and violently agitated by incoming and receding waters. In addition the extrusible anterior pocket, lined with small hooks and spines, is able to keep the head and front part anchored while feeding takes place. The larvae are also tenacious of life to a certain extent and specimens transferred to 60–70 per cent. spirit or to a dilute solution of formalin show active worm-like movements even up to two hours after immersion. Immersion in fresh or sea water does not appear to affect them in any way. One specimen was left in fresh water for several days without showing any signs of being uncomfortable. Specimens may even be left to dry up partially for several hours and will revive again when moistened or immersed in water. All larvae, however, always make active efforts to get out of the water.

Pupation apparently takes place in a tunnel in a fold within the frond, taken up by the larva in its last instar. The pupae may be partially sealed up or entirely enclosed or, as in the laboratory, they may actually be free among the fronds of the seaweed. During the act of emergence the imago drags the pupal case a little forwards and even bends its thoracic part upwards. Such raised empty pupal cases are very common on the fronds of the plants, and during the two months August and September they appeared to be more common at about the middle of these months. The dentate spines along the edges of the conspicuous terminal shield and the pair of recurved apical ventral hooks on the pupal skin probably prevent the pupa from being forcibly removed. The pupa itself is capable of a limited amount of movement and can jerk itself from one position to another to a certain extent. The presence of a spiracular lobe, bearing a distinct spiracular slit, in the pupa proves that it relies on air for purposes of respiration and the entire absence of natatory structures relegates it to the category of air-breathing terrestrial pupae. The length of the larval period is unknown but the pupal period, judging from the few specimens hatched in the museum, is from 4–7 or even more days. There is reason to believe that there is more than one generation in a year, but that the winter, or colder and more moist part, of the year is more favourable.

The larval and pupal stages of this species are remarkable in that the larvae are semi-aquatic in their habits, not existing permanently in the sea water or in rock pools as is the case in most of the other known marine Chironomids. They may be looked upon as being transitional, still connected with the sea in many aspects of their existence, such as feeding on a marine plant, being periodically drenched with sea water and being confined to the littoral zone. On the other hand an existence on exposed rocks at the higher levels between tide marks, where non-marine influences, such as wind, rain, sunshine, fluctuating temperatures and a certain amount of dessication prevail, in conjunction with their apneustic condition and lack of gill-filaments, point to a connection with terrestrial conditions. The pupal stage seems to be even more distinctly non-aquatic as is evidenced by the absence of prolonged active movements, the want of anatomical structures such as filaments and natatory appendages.

In this connection it is also interesting to mention that the food-plant *Porphyra* itself has a similar transitional relation to land and sea. The three known species along S. African coasts, of which *capensis* and *vulgaris* are the most common, seem to prefer or at least to thrive better on the rocks at the higher levels between the tide marks, being only drenched or partially submerged once in twelve hours.

(B) Early Stages and Ecology of *Telmatogeton minor* Kieff., and a redescription of the adults.

Prof. T. A. Stephenson of the Zoological Department of the University of Cape Town has kindly submitted to me 3 ♂♂ and 5 ♀♀ of a species of *Telmatogeton*, which he collected on rocks during an ecological survey of the Riversdale Coast at Stil Bay and at St. James (False Bay). Compared with Kieffer's very short description of *Telmatogeton* (= *Trissoclunio*) *minor* in 1914, *Ann. S. Afr. Mus.*, **10** : 260, and 1920, *loc. cit.*, **17** : 523–528, there is no doubt that these specimens belong to this same species, although differing in details. The types of *minor* were originally described from Mouille Point, but like *T. sancti-pauli* Schin. (= *T. fuscipennis* Kieff.), this species also appears to occur along the South Coast on the Indian Ocean. Owing to Kieffer's inadequate description and the absence of named material in the S. African Museum, a detailed description of the species is appended in order to make its specific position clear and to render its identification easy in case it proves to be a new form.

Telmatogeton minor Kieff.

Length of body about 4–4⅓ mm. (preserved in dilute formalin), 3 mm. according to Kieffer.
,, ,, wing ,, 3–3½ ,, (,, ,, ,, ,,).

The preserved specimens with the eyes, a spot behind each eye, head above in some specimens, clypeus in front, thorax above, the pleural plates, coxae in front, the sternal region, the elongated eighth sternite in ♀ and the sides of eighth tergite laterally in ♀, very dark blackish-brown to blackish; the disc of thorax, however, often with two slightly paler stripes; head above, metanotum and often the trochanters slightly paler and more brownish; scutellum yellowish-olive, often slightly darker laterally; abdomen varying from dull yellowish-olive, olive, to dark brownish-olive and even to blackish in ♂, with the dorsum in both sexes often darker; hind margins of tergites and sternites and the lateral membrane being paler, more yellowish-olive to whitish, with the sides of sternites and tergites, the basal part of abdomen above and below in some ♀♀ and the last two or three segments, as well as the claspers, in ♂ darker and more brownish-olive to blackish, with the upper lateral part and pointed apex of eighth sternite in ♀ pallid or pale yellowish, with the terminal laminae in ♀ pale yellowish-olive to yellowish-white and the dorsal projecting anal tube in ♂ also pallid or whitish; the membranes between pleural plates, posterior membranal parts of coxae and articulating membranes between coxae and trochanters almost white; antennae, face, mouth-parts and legs pale yellowish-white to pallid, only the articulations between femora and tibiae, tibiae and tarsi and between tarsal joints being darkened; the hairs on face, antennal joints, legs and the tarsal claws blackish to black; wings more or less uniformly and subopaquely to opaquely tinged dull cinereous or smoky-grey to greyish-olive and with a dull whitish tint in certain lights; halteres white.

Head with the bristles round eyes well developed, forming a basket-like protection, the tips of the bristles almost touching, with the bristly hairs on convex clypeal region almost absent medially. Antennae (fig. 3, *a*) 7-jointed, often almost 8-jointed, there being a tendency for joint 2, in some specimens, to be divided into two joints, often also with a tendency for joints 5 and 6 to be coalesced as shown in the figure in a ♀-~~paratype~~ (thus 6-jointed); joint 1 subglobular, about as long as broad and with a number of stoutish

/specime

bristly hairs; joint 2 subdivided and shaped as in figure, subequal to 1; joints 3-6 subglobular or very slightly broader than long, more or less subequal and with the respective verticillate setae as shown in the figure; joint 7 the longest, broadest basally and tapering towards apex, with a tendency for the apical part to be indistinctly marked off and also to be slightly darkened in some specimens, with two distinct verticillate setae, one near base and the other apically, as well as a few longer hairs. *Thorax* with a greyish bloom in certain lights, with a dorsal row of separated short bristly hairs on each side of midline and a few others, slightly longer ones, which are closer together and more concentrated in an oblique and irregular row on each side posteriorly in front of wing-bases; all these hairs being situated on pale ocellate spots. Convex scutellum with the bristly hairs sparse, but more concentrated laterally. Wings (fig. 3, *b* of ♀) shorter in ♀, extending to apex of eighth tergite and not reaching apex of terminal laminae or often just extending beyond these, comparatively longer in ♂ and extending beyond apices of claspers; hairs on costal vein short and separated, those on radius more widely separated, sparse and almost inconspicuous, microtrichiae on posterior membrane very fine and not very long. *Abdomen* with scanty short hair, more numerous on venter and towards base dorsally, where they are

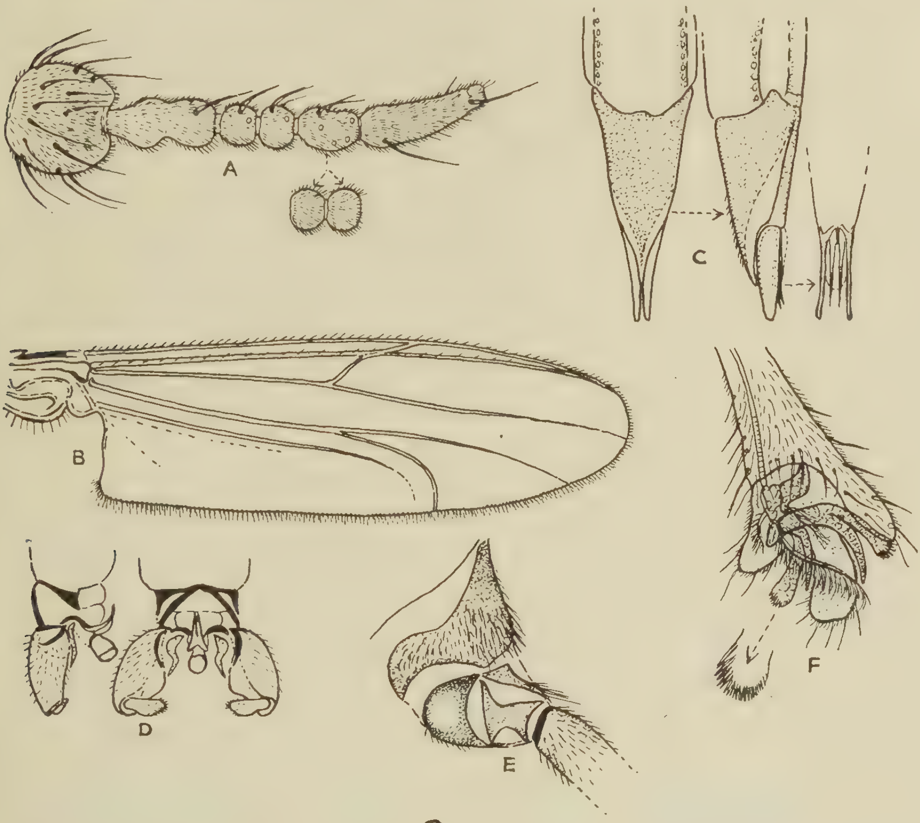

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Fig. 3.—(*a*) Antennal joint of *Telmatogeton minor* Kieff. ♀. (*b*) Wing of ♀. (*c*) Eighth abdominal segment of ♀ from below, side and above. (*d*) Hypopygium of ♂ from above and side, the outer part of side view being ventral. (*e*) Middle trochanter of ♂ from obliquely below. (*f*) Last front tarsal joint of ♂ from below.

also slightly longer, especially laterally; these hairs situated on pale yellowish-white ocellate spots, especially laterally on the segments along lateral membrane. Segment 8 in ♀ (fig. 3, *c*) without any conspicuous hairs ventrally or laterally only with fine and sparse ones towards apex of sternite below, with the sternite more chitinised and acutely pointed at apex; the tergal part above membranous from about bases of the terminal laminae, which membrane is connected with two pointed stylet-like processes between the laminae, not as long as laminae; the terminal laminae projecting sub-horizontally and rounded apically, with the eighth segment and laminae being slightly longer than segments 6 and 7 combined. Hypopygium of ♂ as shown in fig. 3, *d* (from a ventral and a side view), the claspers and attendant sclerites being shown as well as the dorsally directed aedeagus with the still attached chitinous anal tube, which, in an unprepared specimen, is in the form of a prominent whitish membranous process. *Legs* longer and more developed in ♂, with the hairs short and not very dense in both sexes. Middle trochanters (fig. 3, *e*), from below, in ♂ with a feeble knob-like process posteriorly. Tibiae with short spurs apically, without any comb. Tarsi with the middle ones shorter than the others; front and hind metatarsi a little more than half as long as the tibiae; middle metatarsus markedly shorter, often distinctly shorter than half the length of the tibia in ♂, about subequal to half or about half as long as tibia in ♀; joints 2 of the front and middle tarsi subequal to 3 and 4 combined; joint 4 being the shortest, that of the hind tarsus distinctly longer than 3 and 4 combined. Claws in ♀ simple and all alike, slightly longer than in ♂, subequal in length to the middle lobe; those in ♂ with the front (fig. 3, *f*), and middle ones subequal or the inner ones apparently a little longer than the outer ones, shorter than the middle lobe, each with a longer outer process (subequal to middle lobe in length), which is finely otenate apically.

♂♂ and ♀♀ from Stil Bay, 23.i.32 (No. 165).
♂ and ♀♀ from St. James (Cape Peninsula), 11.iv.33 (No. 217).

From labelled paratypes of *Telmatogeton sancti-pauli* Schin. (= *Trissoclunio fuscipennis* Kieff.) in the S. African Museum, this species differs in being very much smaller, with a less darkened abdomen, less darkly infuscated and much shorter wings, comparatively shorter microtrichiae on posterior membrane of wings, much paler and more whitish antennae and legs, much shorter and more inconspicuous hairs on abdomen and legs, with no conspicuous bristly hairs on sides and sternite of eighth segment in ♀, comparatively longer and narrower terminal laminae in ♀, less prominent process on middle trochanters in ♂, without a distinctly marked off apical part on seventh antennal joint, etc.

From the description of *T. minor* Kieff. itself (*loc. cit.*, pp. 260–61), of which the S. African Museum has no specimens, it appears to differ in being slightly larger, with paler pallid or very pale yellowish-white and not brownish-yellow antennae and legs, with the fore tibiae distinctly less than twice as long as front metatarsus, the hind tibiae not "almost treble the length of metatarsus" but distinctly less than even twice the length of this joint and third and fourth hind tarsal joints distinctly very much longer than thick and the terminal laminae of anal segment in ♀ horizontal or sub-horizontal and not curving upwards. Kieffer, however, had only dried, shrunken and faded specimens and these differences may not have been so striking when they were fresh.

Larva and Pupa.

A few larvae and three pupae (1 ♂ and 2 ♀♀), collected among seaweed on rocks between high and low tides at Mouille Point during September, differ structurally and specifically from those of *T. sancti-pauli* Schin. (= *T. fuscipennis* Kieff.) described above. The structure of the enclosed and unhatched insects, as far as this can be made out, corresponds with those adults of *T. minor* submitted by Prof. Stephenson and there is no doubt that these early stages represent those of *T. minor* Kieff.

The Larva.

Length of mature larva about 5 mm. (preserved in dilute formalin).

Superficially these larvae of *minor* are structurally almost indistinguishable from those of *sancti-pauli* (= *fuscipennis*) (fig. 1). The mature larva is, however, considerably smaller. All stages of larvae, however, differ from similar larval stages of *sancti-pauli* as follows :—The entire body is distinctly much darker, more blackish-brown to deep blackish-olive and not pale greenish, greyish or brownish-olive, with the front half more or less always distinctly and uniformly darker and distinctly more blackish and the last few segments paler and more dull greenish-olive to olive, with the head always typically and distinctly, almost entirely, shining black and not pale yellowish or chitinous-brown, with the entire integument of body in life having a distinctly more purplish iridescent sheen; body is more uniformly cylindrical, comparatively much more slender and the thoracic segments scarcely broader or thicker than the abdominal segments; head distinctly more slender and cylindrical, slightly less broad in relation to rest of body in the mature larva, in profile (fig. 4, *a*) comparatively longer and more slender, less rapidly narrowed apically and there not so markedly narrower than base, with the ventral part more apparently and distinctly concave, with the mouth-parts smaller, the clypeal part distinctly narrower, the antennae much shorter and almost insignificant, with the mentum shaped as in *sancti-pauli* (fig. 1) but with the middle apical tooth not sharp and pointed

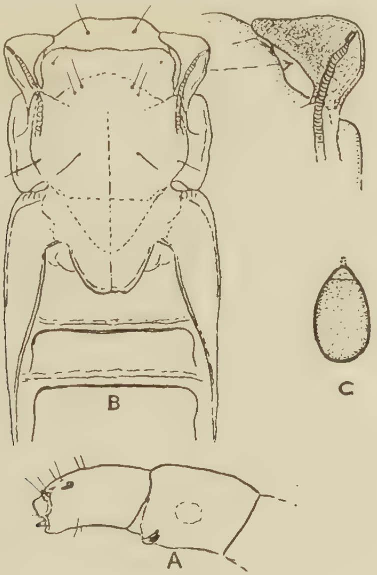

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Fig. 4.—(*a*) Outline of head of larva of *T. minor*. (*b*) Front part of body of pupa of *T. minor* from above with enlarged spiracular lobe to the right. (*c*) Outline of egg from uterus of gravid ♀-pupa of *T. minor*.

but more rotundately rounded and with about five or six teeth on each side, with the mandibles smaller and their apices apparently distinctly blunter; anterior protrusible pocket-like sack ventrally below first thoracic segment comparatively and distinctly less developed in relation to body, less deep and pocket-like, with the spines lining the posterior wall more distinctly grouped into two clumps, which are also relatively smaller, with the anterior spines (those at bottom of pocket) distinctly much longer than similar ones in *sancti-pauli* and apparently also without subsidiary teeth, more claw-like (shaped like third one below enlarged cephalic region in fig. 1), with the smaller spines in these clumps distinctly fewer, more concentrated into two groups and distinctly less extensive than in *sancti-pauli*, where almost the entire posterior wall of pocket is shagreened; bristly hairs on body arranged as in *sancti-pauli* but distinctly less apparent on thorax and abdomen, only the terminal pair on each side being relatively longer; posterior pseudopodal hooks and spines comparatively more slender.

Pupa (fig. 4, *b*).

Length about 3·5–4 mm. (preserved in dilute formalin).

Body of pupa, containing enclosed insect, with the head lobe above and thorax above brownish, the dorsum of thorax being darker and more dark brownish; spiracular lobes often also darker brownish to blackish-brown; hind margins of metanotum blackish; facets of eye dark brownish; sternal regions and leg-cases pallid to whitish; wing-cases whitish, with delicate yellowish-brown margins; abdomen above sooty or cinereous to dark blackish-olive towards base, paler apically and ventrally and more uniformly blackish-grey or dark olive in ♂; terminal abdominal shield pale yellowish or chitinous-brown; tergal and sternal ∩-shaped basal chitinous lines on segments blackish-brown to blackish.

The structural characters do not differ much from those of *T. sancti-pauli* Schin. (= *T. fuscipennis* Kieff.) (figs. 2 and 4, *b*). It is much smaller. *Thoracic region* (shown very much enlarged from a dorsal view in fig. 4, *b*) with the bristly hairs arranged in the same way, with the anterior lobe on head above not distinctly bilobate but more rotundately rounded; dorsum of thorax distinctly less convex, the anterior declivity towards head more gradually sloping, the discal sides less rapidly convex from lateral shelf-like sides, with the integument less rugulose and distinctly less coarsely transversely wrinkled, with the lateral prominence on each side of middle distinctly feebler and almost absent; compressed spiracular lobes shaped as shown enlarged to the right of fig. 4, *b*, distinctly less elongate, comparatively much deeper and higher at about middle, thinner and without any visible tendency to be transversely septate, with the spiracular opening itself smaller, distinctly less elongate and with the tracheal atrium into which it opens narrower, longer, more tubular and not so broadly expanded in the lobes as in *sancti-pauli*; head below with the facets of the eyes more distinctly showing through as blackish-brown spots, with the antennal sheaths much smaller and narrower; wing-sheaths with the main longitudinal veins distinctly less evident and almost absent. *Abdomen* with the lateral membrane or segmented fold between tergites and sternites distinctly more prominently developed and more ridge-like in ♂, with the ∩-shaped transverse chitinous lines across bases of tergites and sternites disposed and arranged as in *sancti-pauli* (fig. 2) but without any distinctly visible transverse shagreened bands of small denticles behind them and with the lateral posterior shagreened patches, of similar denticles on tergites and sternites, comparatively longer transversely on the tergites; terminal shield as in *sancti-pauli* (fig. 2) but smaller, comparatively more narrowed apically in ♀, the sides narrowing more posteriorly, being less subparallel, with the margin of upper overhanging hood-like part provided with more minute and distinctly less prominent otenate spines, with the shield itself less rugose and much more feebly transversely wrinkled above, the edges scarcely or only very minutely jagged or serrated and with the yellowish bristly hairs on these jagged points finer and shorter, with the rest of the black bristly hairs discally above and ventrally below arranged as in *sancti-pauli* (fig. 2) but in ♂ with these bristles comparatively stouter and longer than in ♀, also fewer below laterally towards apex and often with an extra pair above on shield between the upper and lower pairs, with the terminal recurved ventral hooks also distinct and the sheaths of the ♂ and ♀-genitalia as described for *sancti-pauli*.

As is evident from the damaged abdomens of the ♀-pupae, the eggs are already elaborated and far advanced in development, being abundant and closely packed in the ovarioles or uteri, from where they readily burst forth. These eggs are minute and vary in shape from ovate or nearly rounded ones to slightly more ovate and more fowl-egg-shaped ones lower down (fig. 4, *c*). They are pale creamy-yellowish or whitish in utero, with one pole slightly narrower, often even slightly produced into a slight process and with the contents inside nearer this pole whiter and more hyaline. Some eggs in the ovariole also show a slight flattening on one side, which may, however, be due to pressure.

Judging from the gravid condition of the ♀-pupae, it is evident that the adult ♀♀ probably only need fertilisation and that there is very little subsequent development of the eggs in the imaginal period. The imaginal periods of both *sancti-pauli* Schin. and *minor* Kieff. are in all probability thus very short, being mainly occupied in the nuptual flight of swarming of the sexes, when the sexual act is consummated and the fertilisation of already fully developed eggs is initiated prior to oviposition on, or in, the seaweed. The powers of flight of adults of *sancti-pauli*, hatched in the museum, were very feeble and the life of these imagos was also very brief, most of them dying within a day or two. It is thus probable that both species behave more like May-flies and that the short-lived state of the adults is not marked by active feeding periods.

ECOLOGICAL NOTES ON THE LARVAE AND PUPAE OF *T. MINOR* KIEFF.

As in the case of the larvae of *T. sancti-pauli*, the larvae of this species also frequent the same exposed rocks on the higher levels between the tide marks. They are also found on, under, or in association with, the seaweeds *Porphyra capensis* and *vulgaris*. On the contrary, however, these larvae appear to be less common and have not been found occupying joined-up folds in the fronds of the seaweed as is more commonly the case in *sancti-pauli*. They either crawl about freely on the very wet weed or on the wet rock surface under the fronds or they are much more commonly found ensheathed or sealed up in crevices or on the bare rock among or in the neighbourhood of these weeds during low tide. These tunnels, as in the case of some individuals of *sancti-pauli*, are not regularly and permanently constructed tubes as in the case of some other kinds of Chironomids, but are merely irregular temporary sheaths formed by a copious oral secretion of a viscid fluid, which dries up speedily and which at the same time entangles minute grains of sand or bits of shell. The entire larva is covered over with this sheath, lying flat against the rock or in a crevice. Presumably, like *sancti-pauli*, these tunnels are abandoned during immersion at high tide and are not again occupied during the following low tide. A new sheath is simply secreted and the old one becomes blocked up or dried up. Many such visible sheaths, when scratched away, contained no larvae. Moreover, even the very small and minute stages are also found encased or ensheathed during very low tide. The larvae of this species, however, are apparently more inclined to ensheath on the smoother surfaces of rocks, slightly lower in level and which border permanent rock pools midway between the tide marks. They are more often entirely absent or at least much less common than *sancti-pauli* on the more jagged crowns of rocks more elevated in the same zones. They appear thus to be more dependent on moist and damp surroundings, where the weeds become less wilted during very low tide. Like *sancti-pauli*, these temporary sheaths are constructed by the larvae to obviate the possibility of being dessicated during periods of low tide and the wilting of the seaweed. The construction of a temporary tunnel is an adaptation on the part of the larvae to ensure a more or less uniform moist environment for purposes of cutaneous respiration during unfavourable periods of maximum dessication outside on the exposed and dried rocks.

The pupae of this species, which have been collected during September, have been found to occupy tunnels or sheaths on the rock surfaces or in crevices. Externally there was no vindication of the presence of pupae. They were entirely covered over by the viscous and thready secretion of the last larval instars and were only revealed by scratching away the sand-entangled and dried sheaths. Such sand-entangled sheaths are externally indistinguishable from collections of small grains of sand or bits of shell which normally occur in the same situations and which have been driven or carried there by wind or water. In some situations it is thus often difficult to tell whether any crevice contains a sand-entangled sheath of a larva or pupa or merely an accumulation of detritus. No pupae have been found encased in folds on the fronds of the *Porphyra* and neither were any empty pupal cases found lying about free among the fronds of the weed as frequently happens in the case of *sancti-pauli* during its emergence at certain definite times. The pupal period is unknown, but it also is probably short.

ON THE BRUSH-ORGANS OF THE MALE ERMINE MOTH, *SPILOSOMA MENTHASTRI* ESPER

By H. Eltringham, M.A., D.Sc., F.R.S.

[Read 6th December, 1933.]

With Three Text-figures.

My friend Mr. H. M. Edelsten recently called my attention to certain "processes" which he had observed protruding from the abdomen of the male *S. menthastri* Esper, and kindly furnished some examples of the moth for microscopic examination. He informs me that he has long known of the existence of these organs, but is unaware of any published description. I have examined and made sections of them, and find that they are in fact brushes of a rather peculiar kind. If a specimen be dissected from the dorsal side, and the internal organs carefully removed, a structure, more or less diagrammatically illustrated in fig. 1, is found on the internal ventral surface of the 4th, 5th, and 6th abdominal segments. There are two brushes, B1, B2, with a space between, which is occupied by a third B3, formed from two central tufts closely approximated. A curious feature is the curving of the basal part of the hairs. It would appear that portions of two primitive lateral brushes have curved inwards to form a central tuft, B3. All three tufts are evidently extruded between the 5th and 6th sternites, and there is a thin chitinous plate, P, overlying them, in the interior of the abdomen. The muscular equipment is quite unusual and its action rather difficult to understand. There are two muscle bands, M1, M1, adjacent to the lateral brushes, and two shorter and broader ones M2, M2,

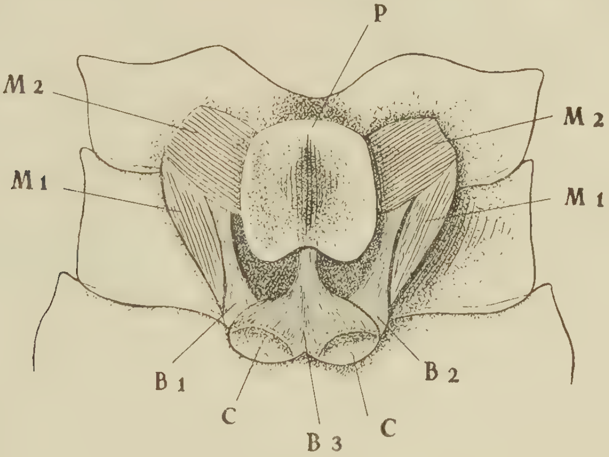

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Fig. 1.—*Spilosoma menthastri* Esper. Diagram of brush-organs in male abdomen. B1, B2, lateral brushes. B3, central brush. CC, concavities in bases of brushes. M1, M2, muscles. P, chitinous plate.

attached to the sternite and to the chitinous plate. As a general rule muscles attached to insect brushes are so arranged as to provide for withdrawal only, extrusion being effected by internal fluid pressure. In this species, however, the lateral muscles at least would appear to control the extrusion.

The base of the brush apparatus shows two symmetrical concavities, C, C, and there is no special or separate gland for the secretion of the scent material. A section through the base of the brushes has the appearance shown in fig. 2. The hair-sockets are long and membranous, and proximally continuous with a deeply plicate tissue which doubtless allows of great expansion. The inner cavity of the brush-base into which the proximal ends of the sockets open, contains blood and also a few fat-cells. Stained preparations show dark granular matter in the sockets and also in some of the hairs. Fig. 3 represents two sockets under a very high magnification. There seems no doubt that there is a unicellular gland in each socket, secreting, by metabolism from the blood, the scent material. This passes into the hair and must be distributed by osmosis, as there is no sign of a porous cuticle.

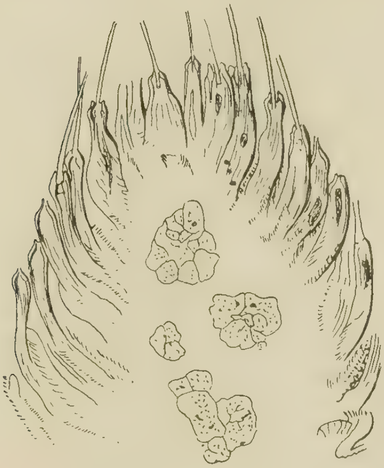

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Fig. 2.—*S. menthastri.* Section through basal part of one of the brushes.

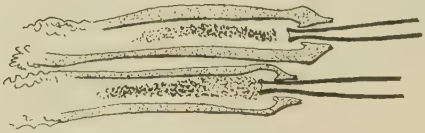

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Fig. 3.—*S. menthastri.* Two hair-sockets from brush, highly magnified. (Diameter of brush-hairs ·005 mm.)

So far I have found no brush apparatus comparable with this peculiar structure. In *Phlogophora meticulosa* L. and other moths there are abdominal brushes but these lie in grooves of the cuticle, such grooves being lined with special scent-scales (1925, *Trans. ent. Soc. Lond.*, **1925** : 2). Brushes with glandular hair-sockets are found in certain butterflies as *Hesta lynceus* Drury and *Trepsichrois mulciber* Hübn. (*loc. cit.*, **1915** : 152). These are, however, of a somewhat different structure. I have examined males of the nearly related Buff Ermine moth (*S. lubricipeda*) but can find no similar organs.

THE METASTERNUM AND PLEURON OF HETEROPTERA

By Maud D. Haviland Brindley.

[Read 6th December, 1933.]

With Plates I–II.

The morphology of the sclerites of the thorax of Heteroptera has as yet received little attention, and the descriptions that have been published usually deal with the more specialised forms in which characters reasonably supposed to be primitive are obscured. The pleuro-sternum in particular has been so modified by consolidation of its plates, and by the development of apophyses for the attachment of muscles, that the original parts are hardly distinguishable. As Snodgrass (1929, *Smithson. misc. Coll.*, **82**) has pointed out, a "generalised" thoracic sternum probably cannot be found in any existing insect; but in some of the Exopterygota, especially where the powers of flight and consequently the pterothorax are not greatly developed, it is possible to recognise a common plan. Some time ago, when studying the scent apparatus of Heteroptera, I reached the conclusion that this plan could still be discerned in the metathoracic pleuro-sternum of certain bugs; and it is the purpose of this paper to direct attention to it.

Without entering into the controversies over the origin of the pleural sclerites and the subcoxal region of the insect leg, it may be recalled that, morphologically, the coxal cavity is bounded mesially by the basisternum in front and by the furcisternum behind.* The anterior and posterior margins are formed by the pre- and postcoxal bridges, which are connected and usually fused with the episternum and epimeron respectively. These pleural plates, divided from one another by the pleural suture, form the outer (lateral) rim of the coxal cavity.

The postcoxal bridge is often so reduced and lightly sclerotised as to appear vestigial or absent; but the precoxal bridge is always present though generally united at either extremity with the basisternum and episternum. When it still appears as a separate sclerite it is known as the laterale. Occasionally, as in the mesosternum of *Forficula*, a suture divides the laterale into a sternal and a pleural moiety. More often, as in the meso- and metasternum of *Blatta* (Pl. I, fig. 1) it is divided into an anterior and an antecoxal portion. Mesially the former abuts upon the basisternum, and the latter upon the anterior angle of the furcisternum.† Other forms which possess both an anterior and an antecoxal laterale are certain Embiidae, some Neuroptera such as *Sialis* and *Corydalis*, the earwig *Echinosoma* in the metathorax (Crampton, 1914, *Zool. Anz.*, **44**), and, according to the same writer, the grasshopper *Dissosteira* (1918,

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* There is considerable confusion over the nomenclature of the thoracic sclerites. Not only have different names been used by different writers for the same plates, but the same name has been given to different parts. For convenience the nomenclature used here follows that of Crampton (1914, *Zool. Anz.*, **44**).

† Snodgrass (1929, *Smithson. misc. Coll.*, **82**) holds that the dorso-ventral flattening of the body, and the great development of the coxae in *Blatta* have led to secondary degeneration of the original sclerotised area of the sternum, and that the condition in this form ought not to be regarded as primitive.

Ann. ent. Soc. Amer., **11**). In higher insects fusion and consolidation of the sclerites, in correlation with the development of the flight muscles, have taken place to such an extent that the pleuro-sternal elements are firmly welded together and the sutures are no longer visible.

If we now examine the metasternum of, for example, the bed-bug (Pl. I, fig. 3), we find apparently a similar division of the anterior coxal bridge into an anterior and an antecoxal piece, and the suture between them is represented by the groove along which the odoriferous secretion flows from the orifice of the stink gland, which is situated at the junction of the outer margins of the basisternum and furcisternum. What is suggested here to be the homologue of the anterior laterale is an approximately triangular plate, fused mesially with the body of the basisternum and in front with its lateral wings. Along its wide outer margin, the laterale meets the episternum in a sharp carina or ridge, and behind it is bordered by the stink groove. The antecoxal laterale is a slender triangular sclerite whose apex meets the anterior angle of the furcisternum behind the odoriferous orifice, and is fused laterally with the posterior region of the episternum. The free posterior margin forms the anterior rim of the third coxal cavity and overlaps the trochantin. The latter, as in Heteroptera in general, is small; and it does not appear that elements of the episternum have fused with it at the proximal end as seems to have been the case with some Neuroptera.

It is of course arguable whether the sclerites described here for *Cimex* are homologous with those similarly placed in other insects. Some writers hold that it is useless even to attempt to homologise the sclerites between one group and another. It is true that as embryological and developmental evidence is usually lacking, and that as the origin and insertion of muscles, which are frequently helpful in the study of the head capsule and genitalia, do not lend much assistance in determining the parts of the sternum, we are obliged to rely on the relations of one sclerite to the rest, and to such constant landmarks as the pleural suture and the sternal apophyses. As far as this comparative method is a trustworthy guide, the arrangement of the pleuro-sternal plates in Heteroptera certainly suggests homology with similar parts in less specialised forms. Against this is the fact that the division in the precoxal bridge occurs only in the metathorax, and then is visible only in those bugs which possess a stink gland. This objection is perhaps met by taking into account the modification of the heteropterous pterothorax. On the analogy of Orthoptera and Coleoptera, it was long assumed that the hemielytra of bugs functioned chiefly as covers for the hind-wings; but as Weber (*Biologie der Hemipteren*, 1930) has recently emphasised, in this group the anterior wing is the principal organ of flight, and the hind-wing is linked to and follows it more or less passively. The mesothorax therefore is much developed to accommodate the increased size of the dorso-longitudinal and dorso-ventral muscles, which, by altering the curve of the tergum, play a large part in raising and lowering the wing. The pleural plates are extended upwards, and the second phragma, to which the dorso-longitudinal muscles are attached, is set backwards at an acute angle to the long axis of the body. The cavity of the metathorax on the other hand is correspondingly diminished by the intrusion of the huge second phragma, while the dorso-ventral muscles are either absent or much reduced. The disappearance of the division of the laterale in the first pterothoracic segment and its retention in the second might thus be explained by the greater development and consolidation of the sclerites to provide a firm base for muscle attachment. But this cannot have been the only determining factor, for there are examples in other groups of insects where the precoxal bridge is also divided in the third but not in the second segment. In fact, wherever this condition occurs in one segment only, the metathorax always is involved, irrespective of wing development. In many Neuroptera and in *Blatta* (Pl. I, fig. 1) the precoxal bridges of both segments are divided; but in an Embiid collected by the writer in Trinidad (Pl. I, fig. 2) the apterous individuals possess separate anterior lateral and antecoxal plates in front of the trochantin in the metathorax, though the mesothoracic precoxal bridge consists only of a single plate between the basisternum and episternum. In alate individuals of the same species, the precoxal bridge is undivided in both segments. In the grasshopper *Dissosteira* Crampton (1918, *Ann. ent. Soc. Amer.*, **11**), figures the mesothoracic precoxal bridge as an undivided sclerite, continuous with the episternum but divided from the basisternum by a suture. In the metathorax, however, the precoxal bridge is formed by a sterno-lateral plate, separated by a suture from the episternum; and, posterior to this, and forming the anterior margin of the third coxal cavity, are an antecoxal piece and a " sterno-laterale." It should be remarked that this interpretation of *Dissosteira* does not altogether agree with that of Snodgrass for the same insect, and Crampton himself finds that the antecoxal and sterno-lateral plates of *Dissosteira* are not distinguishable in the crickets and katydids. Nevertheless the subdivision of the pleuro-sternal region of the third as compared with the second segment of this grasshopper is significant, for in Orthoptera, unlike Heteroptera, the hind-wing is the principal organ of flight, while in EMBIIDAE the wings are undifferentiated, and in apterous individuals the factor of flight does not enter at all. Thus division of the pleuro-sternum of the metathorax appears independently of the degree or nature of wing specialisation. That the division of the precoxal bridge occurs only in those Heteroptera which possess a stink gland is no real argument against its primitive character, for it is usually held that in this family the stink organs themselves are ancient and that their absence is secondary. It is reasonable to assume that glandular organs would open, not on the sclerites themselves, but on the intervening membranous areas. The view suggested here is that the primitive stink apparatus opened at the junction of the outer angles of the basisternum and furcisternum and that the secretion was poured along the natural groove formed by the approximated margins of the laterales. With the consolidation of the thoracic plates, this groove has become obliterated in some families of Heteroptera, and the scent orifice tends to disappear though the organs themselves persist and apparently even function, as in *Notonecta*, *Naucoris*, and *Salda*.

The principal work that deals comparatively with the sclerites of the adult heteropterous thorax is that of Taylor (1918, *Ann. ent. Soc. Amer.*, **11**). He, however, devotes most of his attention to the tergum, and dismisses the sternum briefly with the remark that it usually consists of a single plate. Moreover, while he corrects the errors of some previous observers, he is not always blameless of misinterpreting the homologies of sclerites, even by criteria that he himself recommends, and his researches lead him to the surprising conclusion that *Belostoma* possesses a " somewhat generalised type of thorax." In a group of insects as highly specialised and, geologically speaking, as ancient as the bugs, it is unsatisfactory to assume that this or that form represents the primitive type. As far as it is safe to speculate, some of the Geocorisae, such as the PYRRHOCORIDAE, NABIDAE, and CIMICIDAE, seem to have least adaptive modification of the metasternum. *Cimex* seems to be the most generalised of all in this particular, but the specialised habitat suggests caution in attributing this apparently simple structure to the survival of an ancient type. It may not be without significance that the pleuro-sternum of another apterous flattened form, *Aepophilus* (Pl. II, fig. 1) resembles that of *Cimex* in some ways; but unfortunately sufficient material of this interesting bug has not been available for the detailed study of the sclerites. On the other hand, the metathoracic pleuro-sternum of the related but of course free-living ANTHOCORIDAE differs chiefly from that of *Cimex* in the possession of a small fold or pocket on the anterior laterale which serves to retain the scent secretion. This fold is found in rudimentary form in NABIDAE (Pl. I, fig. 4), a family which possess such "primitive" characters as a well-developed trochantin and postcoxal bridge, and a metathoracic pleural suture and epimeron which are not covered by the posterior margin of the episternum. It occurs in rather more elaborate form apparently in most MIRIDAE, though it is lacking in such BRYOCORINAE as I have examined. In PENTATOMIDAE the fold is large and elongated, and has made secondary connection with the anterior margin of the antecoxale, thus converting the inflated stink-groove into a closed funnel. The fold is also present in COREIDAE (except CORIZINAE and a few Alydini), but in this family, though reflected over the stink groove, it is not fused with the antecoxale, and the groove is not closed (Pl. I, fig. 6). In both PENTATOMIDAE and COREIDAE the furcisternum has tended to shift forward behind the basisternum; and, especially in the latter family, the furcal region has made connection with the anterior laterale above the orifice of the stink reservoir, forming a strong ring round the latter where it opens into the enlarged groove. On the whole perhaps the pleuro-sternum of the PYRRHOCORIDAE (Pl. I, fig. 5) and LYGAEIDAE approaches most nearly to what is suggested here to have been the original form. The scent-retaining fold is absent and the secretion flows along the exposed groove between the two laterales, whose edges in LYGAEIDAE are raised into a rounded margin.

In some land bugs, the posterior margin of the metathoracic episternum is developed into a fold which covers the junction with the epimeron, so that the latter is invisible when the thorax is viewed from the side. Taylor (*op. cit.*) points out the error of Tower (1913, *Ann. ent. Soc. Amer.*, **6**), who in the Coreid *Anasa tristis* mistook the stink groove for the pleural suture and thus confused the metathoracic epimeron and episternum. But he himself, by assuming that the shallow depression along which the free flange meets the episternum proper represents an obsolescent pleural suture, has figured the posterior part of the episternum as the epimeron. In point of fact, the suture is situated immediately behind this depression and is quite well defined; but, together with the narrow epimeron, it can be seen only when the episternal flange is turned forward. The true nature and relationship of these parts can be demonstrated quite clearly if the epimeron of the nymph is compared with that of the adult. This episternal flange is highly developed in the PENTATOMIDAE, COREIDAE, and LYGAEIDAE, but less so in the MIRIDAE. Indeed in some BRYOCORINAE it is absent, and the pleural suture and epimeron are fully displayed.

Free marginal flanges occur also in many if not in most bugs on the coxal borders of the episternum and epimeron and enclose the bases of the legs. They have been termed the subcoxal plates by some writers; but as this name was originally used by Heymons in his developmental studies and carries some ontological implications which do not concern the present work, it has been thought better here to use the term "subcoxal flanges" simply to designate the extended margins of the surrounding plates which overlap the coxae. In some forms these flanges are so large that they apparently replace the episternum and lead to misinterpretation of the neighbouring sclerites. Thus Taylor has figured the subcoxal flange of the metathoracic episternum of *Thyreocoris* as the third epimeron, which actually is hidden behind the free posterior margin of the episternum. What he supposes to be the metathoracic episternum is really the mesothoracic epimeron; and what he designates the katepisternum of the third segment is simply the great episternal flange of the mesothorax which in this family (THYREOCORIDAE) completely hides the base of the leg, and is in no way comparable to the " katepisternum " described by Crampton for some Neuroptera and Homoptera. In THYREOCORIDAE the sternum and the precoxal bridges are greatly compressed, and the scent retaining fold of the anterior laterale is likewise flattened and extended backwards to cover the groove (Pl. I, fig. 8).

The metasternum of REDUVIIDAE presents points of interest. It has been shown (Brindley, 1930, *Trans. ent. Soc. London*, **78**) that the stink apparatus when present, is of a type unique among Heteroptera, and it may have arisen in response to adaptive changes in the thorax (Pl. I, fig. 7). The furcisternum is short and broad, with the furcae set widely apart between the orifices of the stink glands. The anterior laterale occupies the usual position, but the furcisternum has been thrust forward against the antecoxale, which has been displaced outwards and is much reduced.

A stink apparatus has not been described for ARADIDAE, and I have had access to dried material only for the purposes of the present study; but in *Aradus crenatus* Say, the suture between the laterales is still discernible, though the furcisternum is closely approximated to the angle of the anterior laterale where the latter joins the basisternum.

In *Phymata erosa* (PHYMATIDAE) the furcisternum is larger than in REDUVIIDAE and the furcae occupy the normal position; but the laterales are indistinguishably fused together and with the surrounding elements of the sternum and episternum.

In the " lace-bugs " (TINGIDAE) the laterale division is discernible even in *Piesma*, although in this genus the stink apparatus is absent. In forms where it is retained, the suture still functions as the stink groove and is furnished at its extremity with a swollen lip.

Turning to the water-bugs, the adaptation of the legs for swimming has produced great changes in the metasternum. The coxae are enlarged and extend behind rather than from beneath the thorax, so that the metathoracic pleural suture is horizontal. At one time it was doubted whether the pleural plates of the Cryptocerata were homologous with those of other bugs, but Crampton (1909, *Proc. Acad. nat. Sci. Philad.*, **61**) pointed out that Heymons, misled by the dorso-ventral flattening of the thorax of *Nepa*, misinterpreted the sclerites. The epimera and episterna of both segments of the pterothorax are present, but the mesothoracic epimeron (" pleurit " of Heymons) extends back beyond the third coxa and conceals the epimeron of the metathorax. Hamilton (1931, *Proc. zool. Soc. London*, **3**) in a brief account of the thorax of *Nepa*, remarks that the episternum is small and triangular, and that its base articulates with " a dome-like region of the sternum overlying the base of the leg, which, according to Taylor, is part of the episternum itself which has grown on the base of the coxa." This " dome-like region " is simply the subcoxal flange, the backward prolongation of the precoxal bridge. Hagemann in his study of Corixa (1910, *Zool. Jahrb.* (*Anat.*), **30**) follows Heymons in the nomenclature of the pleural plates. He agrees with Schiödte on the absence of an epimeron in the metathorax, remarking that the structures previously described by Fieber as "parapleura," and which he himself calls "paratergites," are: "Keine selbständige Seitenplatte des Thorax." But in fact, as Taylor has shown, and as can be demonstrated by comparison with *Salda* and other forms, the metathoracic epimeron, separated from the episternum by the pleural suture, is clearly visible laterad of the postalar bridge. The definitive "paratergite" is the displaced subcoxal flange of the metathoracic epimeron. The pleural plates occur in all the Cryptocerata, though, especially the episternum, they are much modified. Taylor considers that the mesothoracic episternum of NEPIDAE and the metepisternum of *Belostoma* are divided into an- and katepisternal regions, as in some Homoptera. From his figure of the thorax of *Ranatra*, it is clear that the so-called katepisternum of that form is merely the upper part of the episternum which is divided from the rest of the sclerite, not by a suture, but by an internal ridge from which a pleuro-alar muscle, flexor of the wing, arises. According to Snodgrass (1929, *op. cit.*), in *Dissosteira* this muscle or its analogue arises from the pleural suture, and it appears to do so also in *Myrmeleon* and *Panorpa*; but in all the Heteroptera that I have examined it originates anterior to this point, from the inner surface of the episternum itself, and in the case of *Ranatra* at least I am inclined to think that the posterior part of the anterior basalare sclerite also is incorporated in the region above this internal carina. In the metathorax of *Belostoma* the so-called anepisternum is really the greater part of the episternum which is covered by the posterior extension of the mesothoracic epimeron. The anterior laterale of the third coxal bridge is much reduced and indistinguishably fused in front with the extended lateral wing of the basisternum and with the postcoxal elements of the mesothorax. The antecoxale is large and its subcoxal flange is relatively enormous, covering and enclosing laterally two-thirds of the coxa. There is no stink groove (the odoriferous apparatus is lacking), but the anterior margin of the antecoxale is raised into a crest which helps to complete the posterior rim of the cavity for the second leg.*

In *Corixa* alone among Cryptocerata the stink apparatus possesses external orifices (Pl. II, fig. 4). The anterior laterale is provided with a narrow lamella which covers the stink groove and extends throughout its length to a notch on the posterior margin of the mesothoracic epimeron furnished with bristles to hold the secretion. This lamella, the homologue of the fold described for *Nabis*, is actually all that can be seen of the anterior laterale when the legs are in their natural position; but by raising the mesothoracic coxae, a faint suture marking the junction of the anterior laterale with the lateral lobe of the basisternum may be observed. The antecoxale is represented by a narrow strip along the posterior border of the stink groove, but most of the definitive precoxal bridge in this form consists of the enormously extended subcoxal flange. In section, the division between the laterales can be distinguished as a little ridge behind the stink groove. The latter is more lightly sclerotised and furnished with processes to hold the secretion which flows over it (Pl. II, fig. 3).

In *Notonecta* and *Naucoris* the reduction of the anterior laterale has gone even further. The stink apparatus is present but the orifices and grooves apparently do not function and the flap which covers the latter, though present, is reduced to a semi-membranous fold lying across the posterior margin of the second coxal cavity. In *Nepa* (Pl. II, fig. 5) although the stink apparatus is absent, the vestigial groove remains and can be seen in cleared specimens extending forwards from the inner angle of the third coxal cavity. In *Ranatra* the line of the former stink groove is possibly indicated by a fold running forward on either side above the expanded disc of the basisternum; but it is difficult to determine homologies in this form which has undergone extreme specialisation. For example, the furcal arms are approximated and extended forward in a groove formed by the elongated and inflated disc of the furcisternum, a condition as far as I know unique in bugs.

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* Martin (1896, *Bull. Mus. d'Hist. nat.*, 1896) puts forward the view that in the nymph of *Belostoma* the great subcoxal flanges may have an accessory respiratory function since they are provided richly with tracheae. He also remarks that in *Nepa* a similar flange is borne by the "episternite du mesosternum," probably meaning thereby the posterior prolongation of the mesepimeron.

The condition in *Salda* (Pl. II, fig. 2) is characteristic, and distinct from the types found in water bugs, though there are some resemblances, due no doubt to parallel adaptive changes in the form and position of the coxae. The stink apparatus is present, but the course of the groove is indicated only by a ridge on the precoxal bridge. In *S. littoralis* there is no trace of external orifice to the reservoir, but in *S. pilosella* the former position is indicated by a little imperforate knob. In *Pelogonus marginatus* (PELOGONIDAE) the metasternum is essentially as in *Salda*, but the ridge between the laterales is more clearly defined. In those water bugs in which the legs are much modified for swimming, the furcisternum is tilted in such a way that it forms an acute angle to the body axis, and the furcae project forwards instead of upwards. In SALDIDAE this tilt has not occurred, and although the furcae are inclined forwards, this is due to their form and not to the angle of their base.

The metasternum of the Gerroïdeae, in spite of great modification in other respects, has retained the stink apparatus with its external orifices. *Velia* (Pl. II, fig. 8) is probably the most generalised type and possesses a comparatively large stink reservoir furnished with an accessory gland, which, as has been shown elsewhere (Brindley, *op. cit.*) may reasonably be supposed to be a primitive character. Here the basisternum and anterior laterale are indistinguishably fused. The antecoxales are large, and between them is dovetailed a small round sclerite of doubtful homology. The long axis of the furcisternum is shortened, and the stink orifices are very small and situated side by side on the median line of the body. The stink groove, though apparently no longer functional, is well defined and terminates below the episternal region in a tuft of setae. In *Gerris* (Pl. II, fig. 7) the two laterales are closely united, but in some examples after clearing it is possible to see the line of the former suture. Hence in this form the stink orifices appear to open close to the posterior margin of the sternal plate. The furcisternum is very narrow and concealed by the posterior margin of the coxale except at the inner angle of the coxal cavity. An interesting transitional condition is to be seen in *Brachymetra* (GERRIDAE), where the stink groove still persists between the laterales (Pl. II, fig. 6). It is well marked and extends across the sternopleuron to a terminal tuft of setae, now functionless. The antecoxale is well developed, but the furcisternum is even smaller than in *Gerris*, and can be recognised only as two little triangular plates bearing the furcae, one on the inner margin of each coxal cavity.

No attempt has been made here to compare the thoracic sclerites of Heteroptera with those of Homoptera, for after examination of representative forms from both groups, no such comparison seemed possible. The CICADIDAE with the subdivided pleural plates, a character also seen in JASSIDAE and APHIDIDAE, probably approach most nearly to the original type, and in this respect resemble some Neuroptera; but the other families of Homoptera present such modifications of the coxal articulation, coupled with reduction of the sclerotised areas of the pleurosternum, features that are clearly secondary, that it would be unwise to try and derive the heteropterous from the homopterous type or *vice versa.* In respect of the thorax, the two divisions of Hemiptera appear to have pursued separate lines of evolution.

EXPLANATION OF PLATE I.

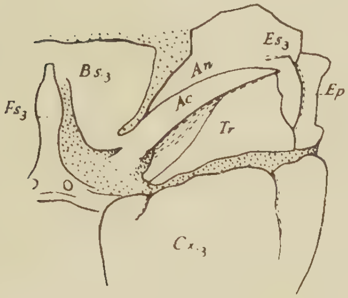
FIG. 1. *Periplaneta orientalis.*
2. *Embia* sp.
3. *Cimex lectularius* (CIMICIDAE).
4. *Nabis* sp. (NABIDAE).
5. *Dysdercus howardi* (PYRRHOCORIDAE).
6. *Nematopus indus* (COREIDAE).
7. *Rhodnius prolixus* (REDUVIDAE).
8. *Thyreocoris* sp. (THYREOCORIDAE).

EXPLANATION OF PLATE II.

FIG. 1. *Aepophilus bonnairei* (AEPOPHILIDAE).
2. *Salda pilosella* (SALDIDAE).
3. Section through the stink groove of *Corixa*, much enlarged.
4. *Corixa fallenii* (CORIXIDAE).
5. *Nepa cinerea* (NEPIDAE). The posterior parts of both epimera are removed to show underlying structures.
6. *Brachymetra* sp. (GERRIDAE).
7. *Gerris thoracicus* (GERRIDAE).
8. *Velia currens* (VELIDAE).

Explanation of lettering used on the plates.

Ac, antecoxale; *An*, anterior laterale; *Bs*, basisternum; *Cc*, coxal cavity; *Cx*, coxa; *Ep*, epimeron; *Es*, episternum; *Fs*, furcisternum; *La*, laterale; *Sc*, subcoxal flange; *Sf*, stink fold; *Sg*, stink groove; *So*, stink orifice; *Tr*, trochantin.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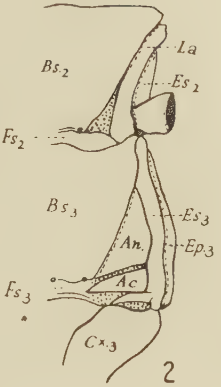
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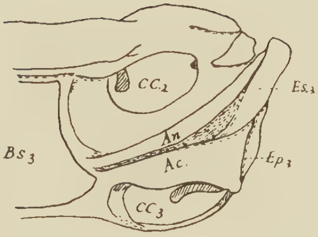
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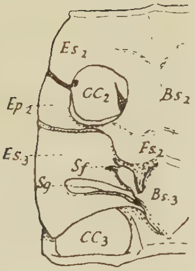
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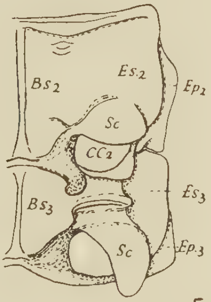
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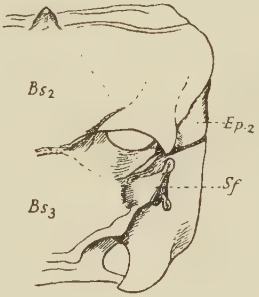
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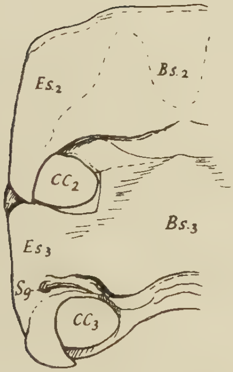
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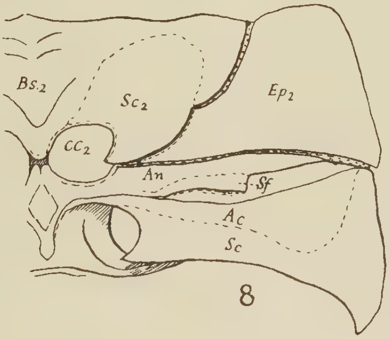
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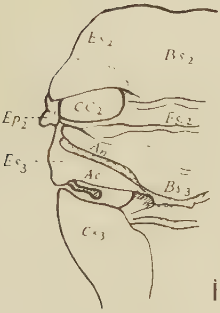
The Metasternum and Pleuron of Heteroptera.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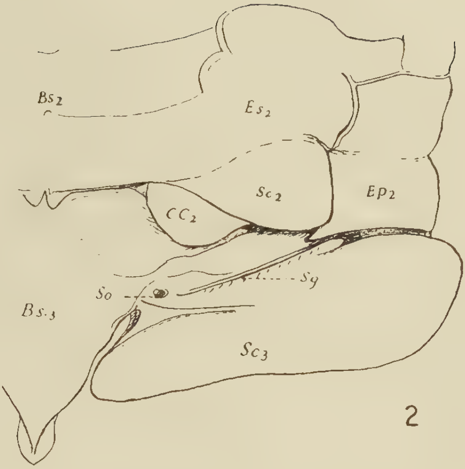
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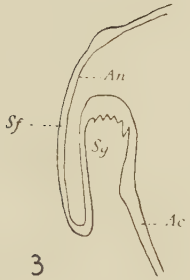

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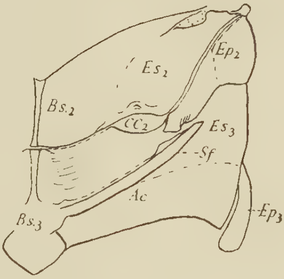
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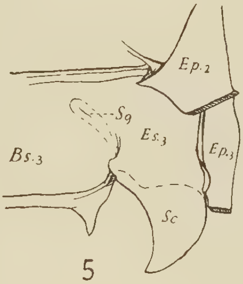
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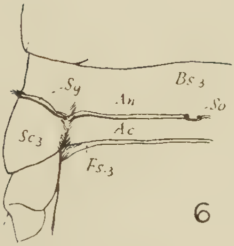
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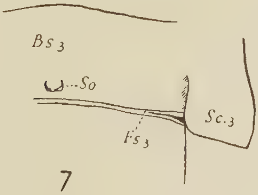
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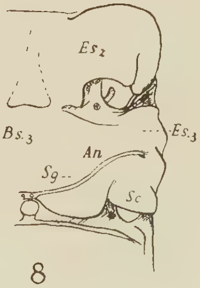
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The Metasternum and Pleuron of Heteroptera.

FURTHER STUDIES ON ETHIOPIAN SIMULIIDAE *

By E. G. GIBBINS.

[Read 4th October, 1933.]

WITH A MAP AND FORTY-ONE TEXT-FIGURES.

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INTRODUCTION.

THERE are few groups of biting insects of medical and veterinary importance in Africa of which so little is known as the Simuliids. Our meagre knowledge of the family was clearly shown by De Meillon (1930),† who stated that of the twenty-four recorded species none of the larvae and but few of the pupae had been accurately described, while the males of ten species remain unknown. Of the habits of these flies information is also very scanty. It has been ascertained that five species bite man, of which two have been found to be carriers of *Onchocerca volvulus* Leuckart and two others are pests of cattle. Recently the writer, working in collaboration with Dr. Loewenthal (1933),

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* I am indebted to the Director of Medical and Sanitary Services, Uganda, for permission to publish these studies. I take this opportunity to express my grateful thanks to Professor G. D. Hale Carpenter, M.B.E., of Oxford, who has spent many years travelling among the islands of Lake Victoria, for information concerning the biting habits of *Simulium adersi*; to Dr. S. A. Neave, O.B.E., of the Imperial Institute of Entomology, for his kindly help with regard to literature, and to Dr. F. W. Edwards of the British Museum, who kindly read through the MSS. and allowed me to examine the National Collection of SIMULIIDAE. My thanks are also due to the Provincial Commissioner, Buganda, for placing a launch at my disposal for the purpose of visiting Nsadzi Island, and to Mr. G. L. R. Hancock, Entomologist, for his friendly assistance on that occasion.

† The early stages and adults of *S. damnosum* Theo. have since been described by the writer in volume 81 of this Journal.

TRANS. R. ENT. SOC. LOND. 82. PART I. (JUNE 1934.)

proved by dissection that *Simulium damnosum* Theo. is also a carrier of *O. volvulus* in Uganda.

It was in an endeavour to fill this gap in our knowledge that attention was devoted to the SIMULIIDAE, as opportunity occurred, while on safari in various outlying districts of Uganda during 1932. In the course of this time a large collection was accumulated comprising the larvae, pupae, and adults of many species, most of which are new to science.

The watercourses of Uganda are many and varied and some are particularly suitable for the early stages of these small insects. There are the dashing torrents of Mount Ruwenzori, the waterfalls of Mount Elgon, the rapids of the Nile, and innumerable other smaller streams as well as the wave-beaten rocky shores of the islands in Lake Victoria, all of which were found to have their own particular Simuliid fauna. In the time at my disposal it was not possible to go fully into the bionomics of each species, but the habitat of the early stages was observed in every case. The degree of aeration of the water appeared to be the all-important factor: certain species were only found in places where the water was aerated to an extreme degree, while others were found in cool sluggish streams where no aeration was perceptible, although doubtless a small amount of dissolved oxygen was present. The early stages were never found in still water or in water which remained stationary over short periods. The temperature and illumination of the water and the presence of vegetation or of organic and inorganic matter in the water were found to be important secondary factors. Many species did not confine themselves to one particular type of habitat, while others were more specialised and could be correlated with certain peculiarities of their breeding-place.

The presence of blood-sucking *Simulium* on the islands of Lake Victoria was first recorded by Professor G. D. Hale Carpenter, M.B.E., in his book *A Naturalist on Lake Victoria* (1920), in which he refers to the fly as being particularly troublesome on certain islands and when in abundance rendering places unapproachable. Early in 1932 Mr. C. W. Chorley, Sleeping Sickness Inspector, brought in for determination from Nsadzi Island several specimens of *Simulium adersi* Pom., which were being caught in traps installed for the purpose of trapping tsetse flies. Later the writer paid a visit to the island and in the short time available was fortunate in finding their unique breeding place * in the rough water along its rocky coast, and was able to secure ample material of the early stages for breeding adults and for subsequent morphological study.

The accidental capture of *Simulium* in tsetse traps suggests a possible means of control for this insect. A study of the breeding habits of *S. damnosum* Theo. (Gibbins, 1933) and of *S. adersi* has proved the futility of attempting to attack the insect in its early stages. The institution of suitable traps along the River Nile may be the means of reducing *S. damnosum* and rendering habitable vast tracts of extremely fertile cotton-growing country. This method of control may also be found of value at Jinja (a town situated at the source of the Nile) where *S. damnosum* is a troublesome pest at certain seasons, invading the township in large numbers and attacking the residents most viciously when in their gardens and on open verandas.

Pomeroy (1916) found the number of the filaments of the respiratory organ of the pupa constant for each species, and remarked upon them as being an excellent systematic character. An extended series of observations on

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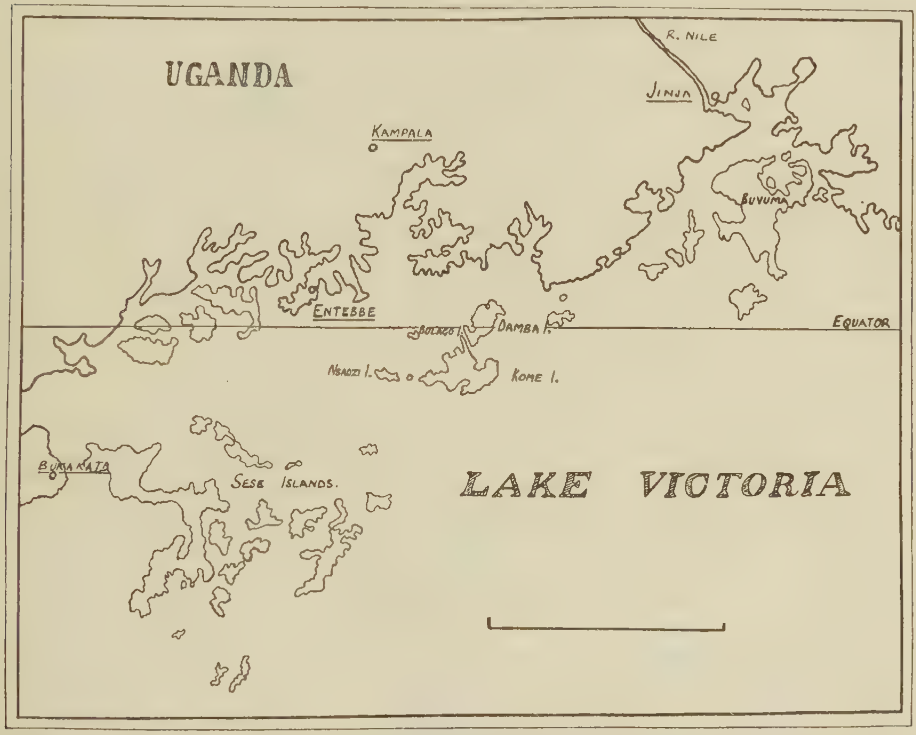
* The early stages of *Simulium* do not appear to have been recorded previously from a similar type of habitat.

African species (1920) confirmed him in this opinion, but later (1921) he modified it by stating that while the structure of the chitinous wall of the filaments was constant, their general arrangement and number varied. This view was expressed after examining specimens of *S. hirsutum* and *S. alcocki*, when he found that although the chitinous structure of the outer wall was identical, the number and arrangement of the filaments varied considerably. The various forms observed were described as varieties. In this study the form of *S. hirsutum* known as var. *adersi* is shown to be a distinct species, and the other variety of the same species known as var. *dubium* has also been found to be distinct. A study of the respiratory organ of thirty-one different species has shown that the structure of the outer wall of the appendages is constant within a given species, although the same structure may be seen in several species. Apart from malformation, which rarely occurs, the number of appendages comprising the organ is constant; but again this character is not in itself of specific value, since more than one species (as shown in the present paper) may have the same number of filaments as well as an outer wall of identical structure. Nevertheless, the writer has found the respiratory organ of the pupa of the utmost value in distinguishing between the various species, and by a detailed microscopical examination of carefully mounted specimens with the appendages arranged in their natural relative position, has been able to separate all the species in his collection on a combination of the characters of this organ.



Map of north-west corner of Lake Victoria showing the situation of Nsadzi Island. The line at the right hand side of the map represents 30 miles.

In the present contribution, it is intended to deal with the early stages and the adult of both sexes of *S. adersi* Pom., *S. dentulosum* Roub., and seven new species. They are arranged in groups on the character of the respiratory organ of the pupa which has been found to coincide with adult terminalia of similar type. The first mentioned, which belongs to the *hirsutum* group, is included on account of its importance as a human blood-sucking species and is dealt with separately. It is not proposed at this juncture to make use of subgenera. Later, as time permits, it is proposed to deal with the other species in a similar manner.

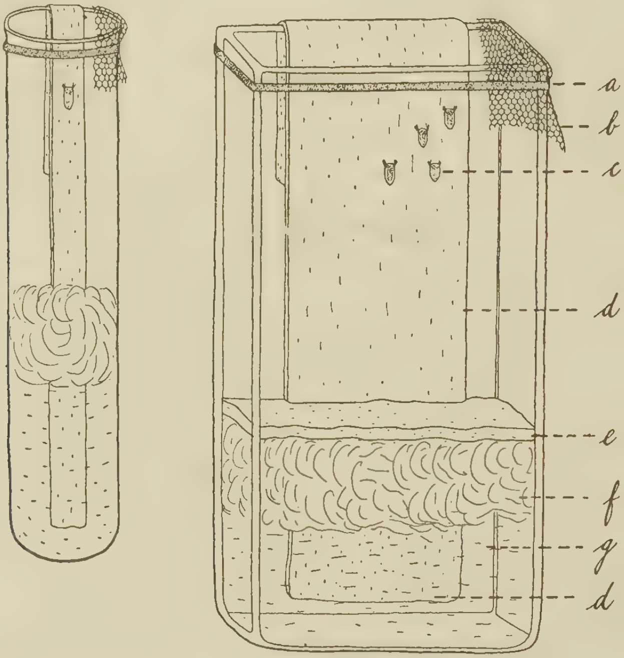


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Fig. 1.—Illustrating the method used for rearing adults from pupae. Left, large test tube (6″ × 1″) for individual pupae. Right, rectangular museum jar (6″ × 3″ × 1½″) for rearing adults in bulk: rubber band (*a*); cotton netting of fine mesh (*b*), pupa (*c*), strip of lint (*d*), small piece of lint (*e*), cotton wool (*f*), water (*g*).

Method of Rearing Adults and Routine Procedure.

Newstead (1907) observed that if *Simulium* pupae are removed from their habitat and kept in a humid atmosphere they will complete their metamorphosis. By placing specimens on damp blotting-paper and removing all excessive moisture he was able to rear adults with comparative ease; Edwards (1920) found the method invaluable when engaged in a study of British Simuliidae. This method of rearing *Simulium*, though excellent in temperate climes, is not satisfactory in the tropics owing to the difficulty of keeping the pupae moist on account of rapid evaporation.

The writer's method, by means of which numerous perfect adults were obtained, was to utilise rectangular museum jars (6″ × 3″ × 1½″) for rearing adults in large numbers, and wide test tubes (6″ × 1″) for individual specimens. Figure 1 illustrates the method. Mature pupae were carefully removed from their fixtures on the point of a sharp scalpel and placed in their natural position on the rough side of a moistened strip of lint,* which was gently lowered into the jar and allowed to adhere to the side in an upright position for transportation to the laboratory. Immediately on arrival the lint was removed and the respiratory organ of each pupa examined with a hand lens of high magnification. It was generally possible to separate them into different species on this character with a certain amount of accuracy, but a number of individuals of each form were always isolated in test tubes (fig. 1), the remainder being placed on different moistened strips of lint and arranged in separate

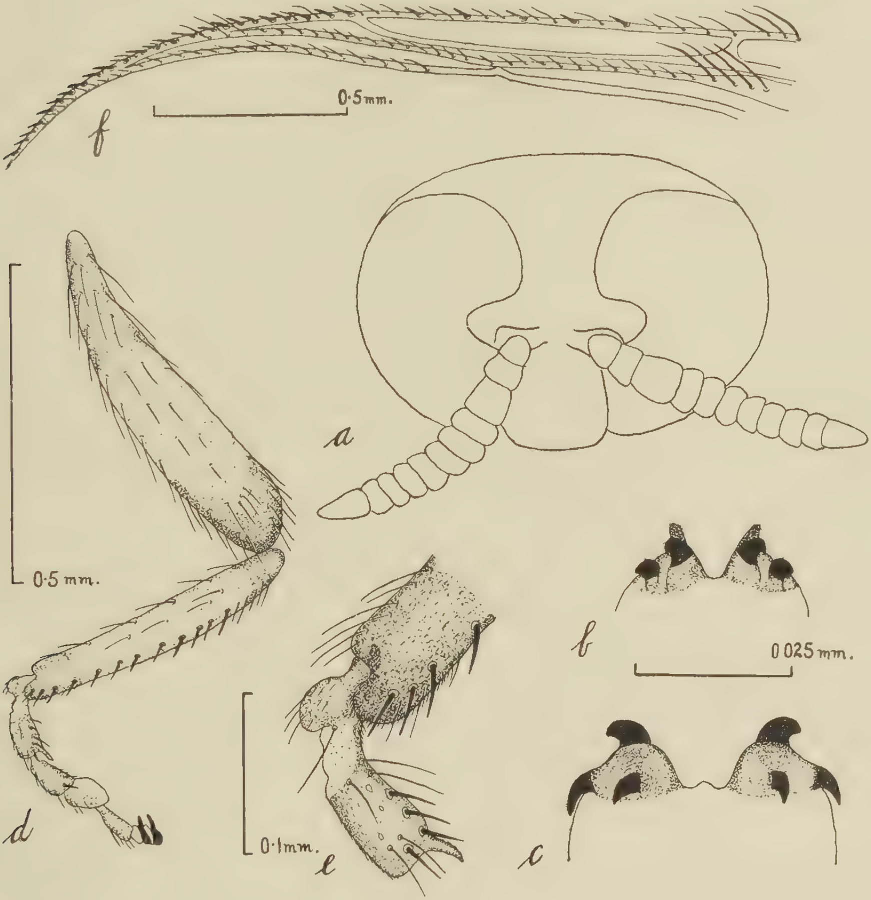

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FIG. 2.—*Simulium adersi*, female; head showing vertex and antennae (magnification as 2, *d*) (*a*), terminal hooks of labrum-epipharynx of *S. adersi* (*b*) and *S. damnosum* (*c*), hind leg of male (*d*) and part enlarged to show calcipala and pedisulcus (*e*), wing of female (*f*) showing anterior venation and distribution of setae.

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* Plain, non-medicated surgical lint.

jars. The lint should be lowered into the jar so as to reach the bottom and hang over the top in the manner indicated in the figure. It will be found that the pupae adhere to the lint quite satisfactorily when in an upright position if not subjected to undue shaking. Clean water is then poured slowly down the side of the jar to the depth of about 1½ inches (care being taken in this process not to pour it in suddenly and so dislodge the pupae), and a wad of cotton-wool placed on the surface of the water. The next step is to insert a small piece of lint, cut to the exact size of the inside of the jar, and manipulate it so as to rest upon the wool and completely cover the entire surface; it should be made to fit exactly, as its purpose is to prevent newly-emerged adults damaging themselves by becoming entangled in the cotton-wool or coming in contact with the water. In spite of this precaution some species insisted on endeavouring to get between the lint and the wall of the jar, particularly when they were present in numbers. The layer of lint was not found necessary for isolated specimens in test tubes. Finally the jars are covered with a piece of fine-mesh cotton netting, which is tightly secured by a rubber band.

At intervals the newly-emerged adults were transferred to dry jars, where they were allowed to live for a short time, prior to pinning, in order that the integument might harden without fear of damage to the insect by its wings coming in contact with the damp walls and adhering to the jar. The transference was a somewhat tedious process, but was successfully carried out by darkening the jar so as to emit light only through the aperture of the vessel into which the flies were being enticed.

In the case of isolated specimens the respiratory organ of the pupal pelt was dissected out and permanently mounted in lactophenol on a slide in the manner described by the writer for mounting mosquito larvae (1930); the slide and the adult bred from the same pupa were afterwards given identical numbers and put away for subsequent study. The pupal cases of each batch of flies emerging in the jars for breeding in bulk were also kept separately in small tubes of fixative and given a corresponding number in the same way. Later, they were taken out and examined microscopically to ascertain if they were all of the same species, and in the case of batches found to be mixed the adults were put aside for subsequent identification. In no case were other than isolated specimens relied on for the identification of the early stages.

SPECIFIC DESCRIPTIONS.*

GROUP OF *Simulium hirsutum* Pom.

Simulium adersi Pom.

(*Simulium hirsutum* Pom., var. *adersi* Pom.)

The adults captured in tsetse traps on Nsadzi Island were all females, and they proved identical in terminalia and external characters with those reared from pupae collected in the same locality. From the nature of the respiratory organ of the pupa, which is a diagnostic feature in *Simulium*, the insect would appear to be *S. hirsutum* var. *adersi* Pom. This variety was established by Pomeroy (1922) for specimens collected in Zanzibar which differed from true *hirsutum* in the number and arrangement of the appendages comprising the pupal filaments. Dr. Carpenter's specimens taken in the act of biting were determined as *S. hirsutum.* In view, however, of its disagreement in certain external characters in both sexes and in the male terminalia with true *hirsutum*, it is proposed to give this form the status of a species.*

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* In every case the adults are described from specimens reared from pupae. The figures have been drawn by the writer from carefully mounted preparations.

Female. Length 2 mm. Wing 2 mm.

Head (fig. 2, *a*). *Vertex* and *front* densely covered with narrow silvery-grey scales. Labrum-epipharynx (fig. 2, *b*: *S. adersi*; 2, *c*: *S. damnosum*). The terminal hooks differ from those of *damnosum*; in *adersi* each pair of hooks comprise two strongly chitinised recurved teeth and one less-chitinised straight distal tooth, whereas in *damnosum* all three teeth are recurved and exhibit equal chitinisation. *Antenna* (fig. 2, *a*) eleven-segmented, dark brown with a fine ash-grey pubescence excepting the scape and basal segments which are light brown.

Thorax dull slate-blue. Mesonotum densely covered with closely applied scales, those disposed laterally and anteriorly silver-grey, those arranged dorsally brassy. *Scutellum* with brassy scales and long marginal hairs. *Pleura* with a patch of silver-grey scales † on the membranous area behind the thoracic spiracle.

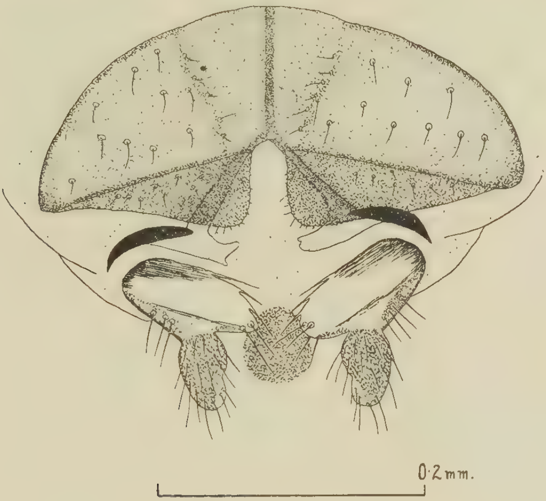

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Fig. 3.—*S. adersi*, female terminalia in ventral aspect.

Abdomen dark brown, thickly covered with narrow golden scales dorsally and silver scales laterally; terminal segments with long pale hairs interspersed. *Spermatheca* dark brown, oval, unsculptured, and strongly chitinised; duct unchitinised. *Terminalia* (fig. 3). The anterior gonopophyses terminate in a spiculate rounded process; paraprocts moderately chitinised, bare of setae on the upper surface and with a few stout bristles on the inner and basal sides; cerci strongly chitinised with numerous long bristles.

Legs dark brown. Coxae and trochanters pale with yellow scales. Femora sprinkled

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* In this connection it is of interest to note that Dr. F. W. Edwards, in a footnote to De Meillon's paper (1930) concerning this variety, mentions that " the pupa of this form is so different from that of typical *S. hirsutum* that it seems very probable that it will eventually be found to be a distinct species."

† These scales are very easily detached and may be few in number or absent in specimens caught as adults; their bases, however, can be distinctly seen in macerated and cleared preparations.

with pale scales. Tibiae with basal two-thirds pale-scaled. Hind legs with basal two-thirds of first tarsal segment pale; pedisulcus well marked. Claws with well-developed basal projection.

Wings (fig. 2, *f*). Without basal cell; base of radius with dark hairs; *Rs* simple; Cu_2 with distinct double bend.

Male. Length 2 mm.

Head. Eyes closely approximated. *Front* dark grey; *clypeus* light grey; the former bare of setae and the latter covered with long dark hairs. *Antenna* as in female.

Thorax velvet-black. Mesonotum densely covered with closely-applied narrow silvery-grey scales anteriorly and laterally, and with brassy scales disposed less thickly dorsally. *Scutellum* black, sprinkled with yellow scales and long erect marginal hairs. *Pleura* as in female.

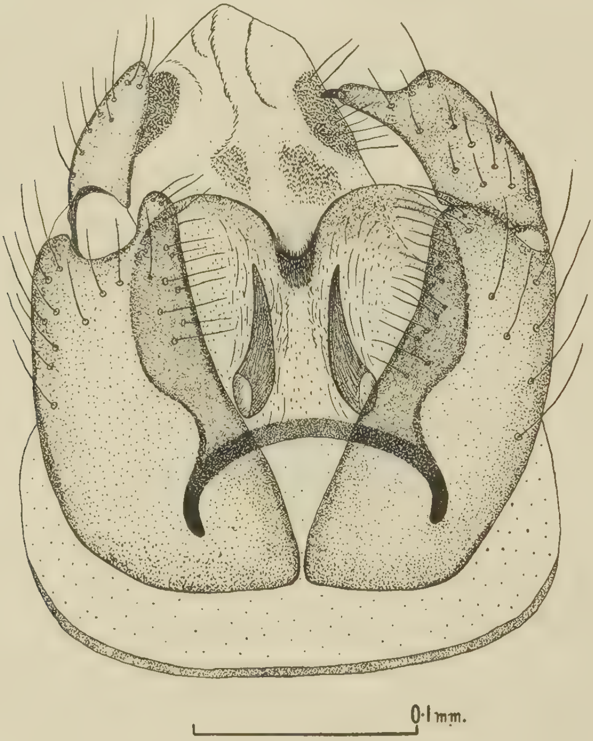

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Fig. 4.—*S. adersi*, male terminalia in ventral aspect.

Abdomen velvet-black with long hairs and sparsely sprinkled with dark scales. Segments two, five and six with golden scales disposed rather thickly dorsally; the latter two segments with a broad conspicuous grey patch sprinkled with pale yellow scales laterally. *Terminalia* (fig. 4). Coxites broad and long, slightly concave on the inner side and with long stout setae on the anterior distal and lateral surfaces. Styles, short and flattened; conical in lateral aspect and about half the length of the coxite; basal portion broad and with a peculiar attenuated anterior process terminating in a stout strongly chitinised thumb-like projection. Intercoxal piece large and broad, covered with fine setae. Situated between this organ and the proctiger are two strongly chitinised horn-shaped processes which appear to be analogous with the parameres of Edwards (1931).

Legs dark brown with long hairs; front femora with basal two-thirds pale-scaled; pedisulcus (fig. 2, *e*) well marked. Claws shoe-shaped with turned-up toe and high heel.

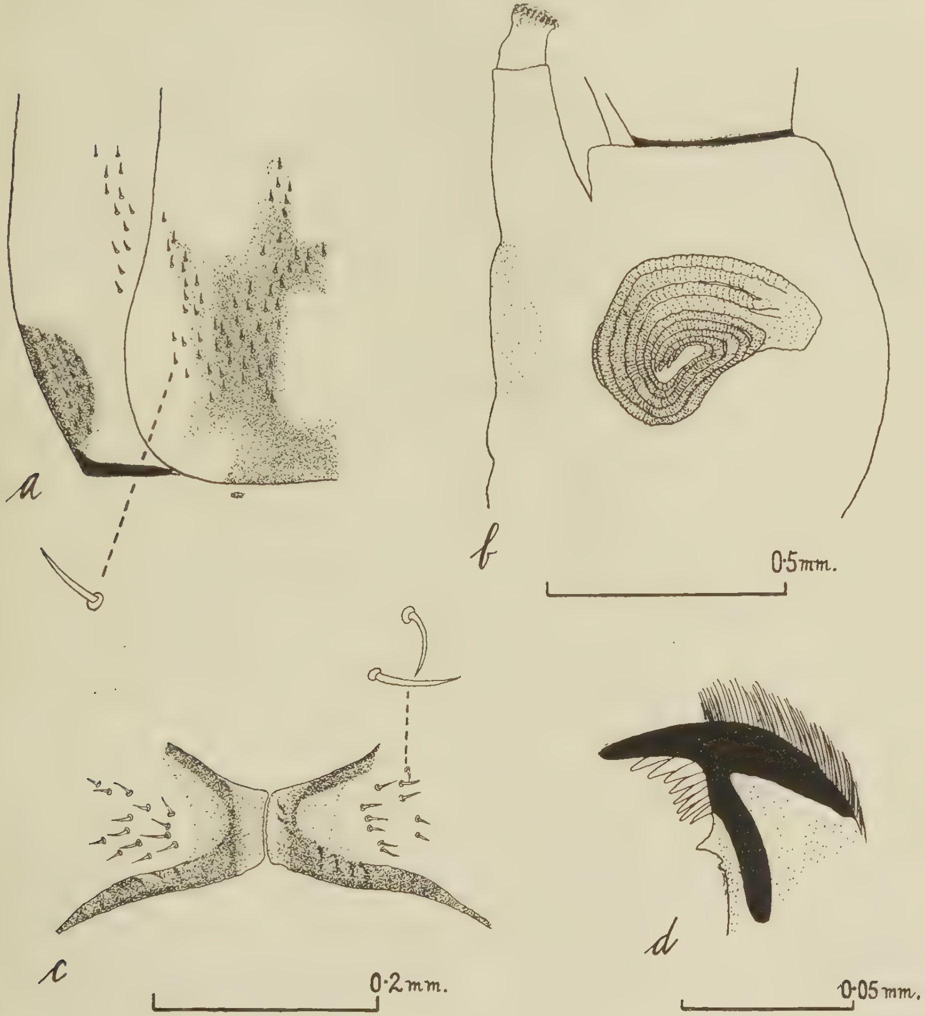

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Fig. 5.—*S. adersi*. Larva, part of head showing pigmented areas (magnification as in fig. 5, *c*) (*a*), thoracic patch and pseudopod (*b*), anal armature (*c*), and mandible (*d*).

Wings as in ♀.

Uganda : Nsadzi Island, Lake Victoria, 8.viii.1932, 18 ♀♀, 10 ♂♂.

Larva. Length 5·8–6 mm. General colour slate-grey.

Head armed with minute spines. A semi-circular pigmented area studded with numerous spines is situated laterally below the eye. *Front* with a pigmented area as depicted in figure 5, *a*. *Antenna* of moderate length, consisting of four segments, the whole slightly longer than the base of the feeding-brushes; the second segment twice as long as the first and bearing at its distal end two knob-shaped sensory processes, third about as long as the first and lightly chitinised, fourth consisting of a small cone. *Mandibles* (fig. 5, *d*) with a main strongly chitinised bill-hook shaped tooth with strong erect hairs extending forwards from behind over two-thirds of its convex surface; nine small secondary teeth, unchitinised, project from its concave surface, the lower tooth being triangular in shape. *Mentum* (fig. 6) with a terminal row of nine strongly-chitinised teeth; between the median and the outer, which has a shoulder on its inner edge, are three, blunt, uniform teeth; on each side are four forwardly projecting lateral teeth, all excepting the anterior unchitinised, and a single row of four stout spines, which arise from clearly-defined bases and progressively increase in size distally; a pair of smaller spines arise sub-medially, a little above the base on either side. Feeding-brushes with 28–32 bristles.

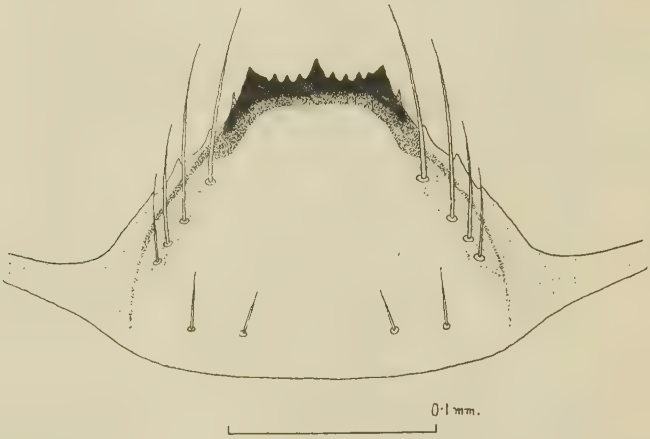

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Fig. 6.—*S. adersi*, mentum of larva.

Thorax. *Thoracic patch* irregularly oval as depicted in figure 5, *b*. *Thoracic pseudopod* moderately long and slender, tapering gradually and about twice as long as its width at the base.

Abdomen. Terminal segments with scattered, minute, narrow spines, irregular in size and lightly chitinised for two-thirds of their length. *Anal gills* trilobed, each lobe comprising a main and a smaller secondary appendage. *Anal armature* as in figure 5, *c* with minute, unchitinised, rectal spines. *Anal sucker* with about 120 rows of 19–25 hooks.

Pupa. *Head* and *thorax* covered with disc-like tubercles; trichomes simple, moderately long and slender. The respiratory organ (fig. 7) is pale and semi-translucent. It is composed of eleven long, slender filaments, which are flexible and able to withstand the severe buffeting to which they are subjected, with very little damage. Few specimens were found with broken filaments. Pomeroy (1922) accurately describes their general arrangement as follows: "The respiratory filaments are 11 in number, arising from three main stems at the base; the first divides into three branches; the second divides into three, first again dichotomously, making five in all; and the third divides into three very near the base." It will be seen that this description agrees closely with the writer's camera-lucida drawing made from material collected in Uganda.

Abdomen with a pair of strong inwardly curved terminal hooks. *Dorso-lateral surface:*

third segment with four equally spaced hooks, seventh with three spines and eighth with four strong spines, the median of which are closely approximated. *Ventro-lateral surface* with a pair of widely spaced hooks on the seventh segment.

The *cocoon* (fig. 8) is a slipper-shaped structure of finely woven threads, 4 mm. long.

*Breeding places.**

The early stages of *S. adersi* were found in the extremely rough water off a rocky point on the south side of Nsadzi Island. At the time of the writer's visit the lake-level was high; there was a heavy swell and " white horses " were prominent. The larvae and pupae were found in water varying in depth from six inches to three feet or more, depending on the action of the waves, attached to the clean smooth roots of trees running along crevices in the shelving rock. In this area the waves were dashed to foam and the water was highly aerated. According to the local inhabitants the lake along the southerly coast of this island, which is not sheltered, is always rough. Several hours were spent examining the rocks and aquatic vegetation at various places along the lee shore, but no *Simulium* were found.

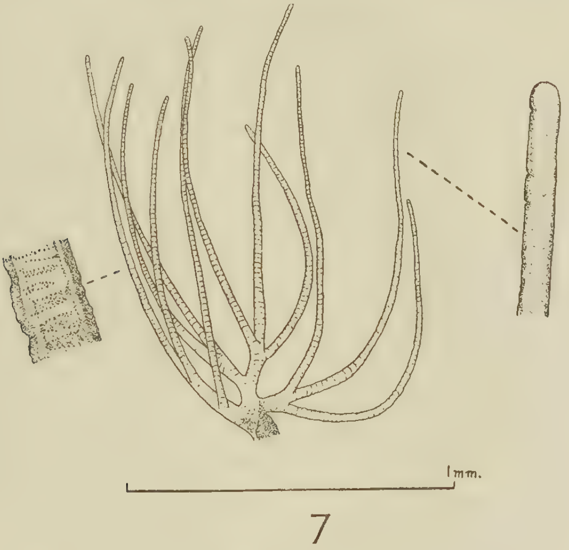

FIG. 7.—*S. adersi*, respiratory filaments of pupa.

Pomeroy (1922) obtained the original pupae from grass blades in a small stream in Zanzibar, and Edwards in a footnote to De Meillon's paper (1930) records the presence of pupae which agree with this species in a small stream at a spot about 15 miles south of Rejaf in Southern Sudan.

The following information concerning the habits of the adult is taken from Prof. Carpenter's book (1920), as unfortunately during the writer's brief visit adults were not active and no specimens were taken on the wing. On July 26th, 1914, the author relates having been set upon, before breakfast, by a viciously biting swarm of *Simulium* near the rocky shore of Kome Island, which is separated from Nsadzi by a narrow channel. He notes that they are especially eager to bite in the early morning or evening when rain is threatening, and observed that whereas *Simulium damnosum* attacks particularly the lower extremities, the island species makes for one's head and neck and especially the ears.

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* In view of my findings it is of interest to note that Prof. Carpenter (1929) was of the opinion that the larvae would be found along the rocky coasts of the small islands. At the time of the investigation the existence of this note was not known and the writer is indebted to Dr. F. W. Edwards who called his attention to it some eighteen months later. It may be mentioned, however, that the writer was informed, when in conversation with Professor Carpenter subsequently, that no specimens of the early stages were obtained to support this hypothesis.

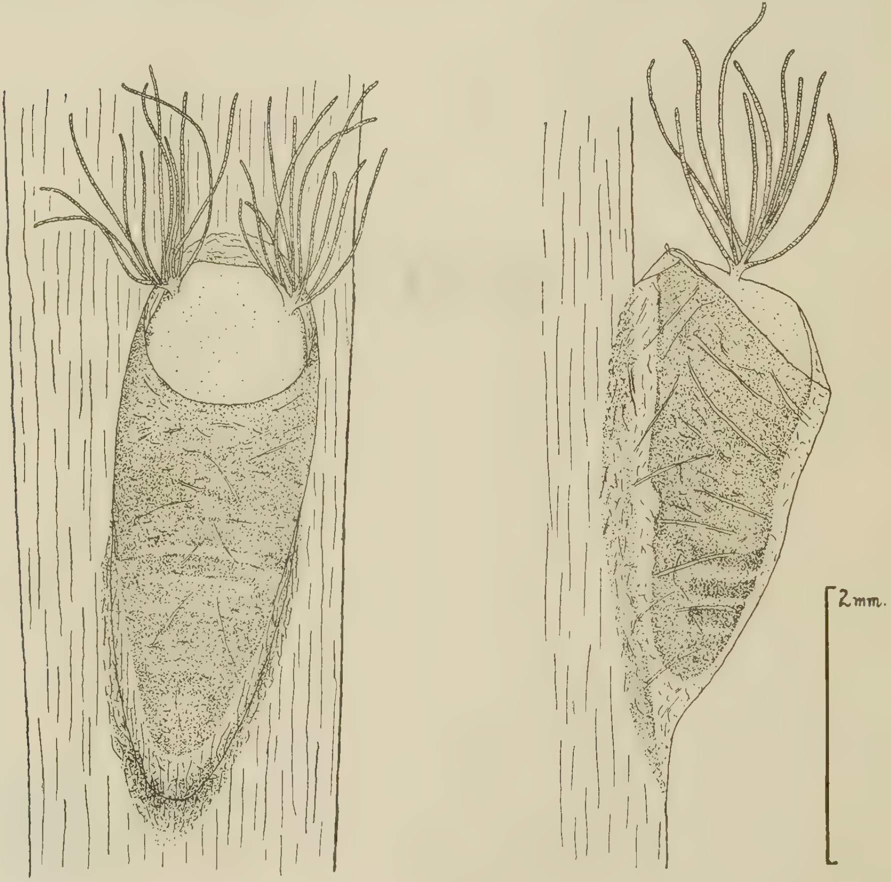

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Fig. 8.—*S. adersi,* pupa and cocoon; ventral view left, lateral view right.

Group of *Simulium gilvipes* Pom.

The members of this group are closely allied to *S. gilvipes* Pom., and all carry the patch of soft hairs on the membrane behind the thoracic spiracle. In each case the pupal respiratory organ consists of ten to fourteen strong, uniform, paired filaments, and under high magnification the outer wall is seen to be covered with minute, pigmented, circular nodules which are arranged in rows over their entire surface with the exception of the tip. During the study of these species a useful distinguishing character in the female was revealed in the presence and formation of a large raised chitinised plate situated medially on the eighth sternite; this may be clearly seen in macerated and mounted preparations. In addition the adults have the following characters in common : antennae eleven-segmented, legs with calcipala present and pedisulcus distinct, front tarsi not flattened, claws with a well-developed basal projection and abdomen dull in the female, terminalia of similar structure, wings with hairs on the base of the radius and subcosta, spines interspersed with hairs on the costa, the radial sector simple and the cubitus with a distinct double bend. The larvae are characterised by the absence of scales and spines and anal gills of a similar type.

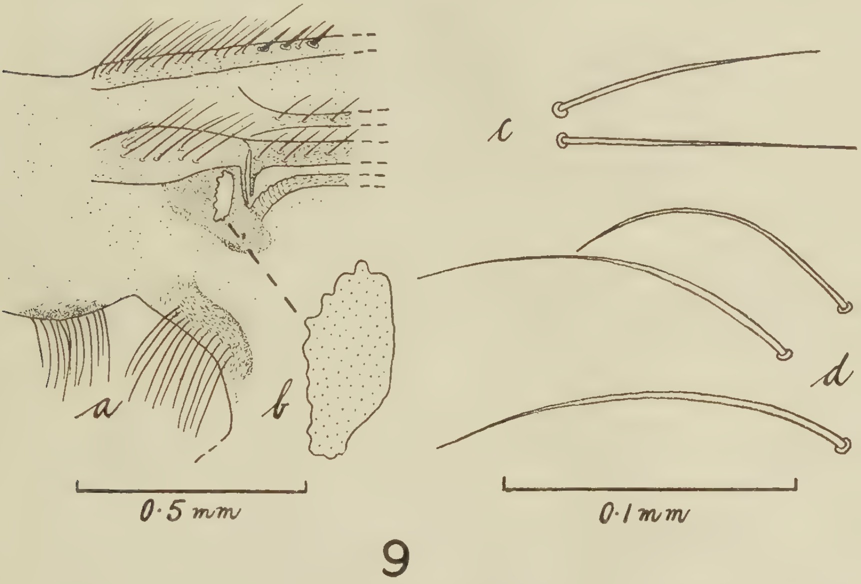

FIG. 9.—Adult. Base of wing of *S. nili* showing basal cell (*a*), cell enlarged (*b*), Pleural hairs of female *S. nili* (*c*), *S. ruwenzoriensis* (*d*).

Simulium ruwenzoriensis sp. n.*

Female. Length 3·1 mm.; wing 3·5 mm.

Head. Vertex and *front* slate-grey, and with dense closely-applied golden scales; front of normal width. *Clypeus* light grey, with moderately long hairs interspersed with golden scales. *Antenna* eleven-segmented, entirely dark brown with the exception of the scape and basal flagellar segment which are somewhat paler and covered with a fine grey pubescence.

Thorax. Integument of mesonotum dull-black with pale yellow scales, which are thinly disposed medially. *Scutellum* with yellow scales and long marginal hairs of similar colour. *Pleura* velvet-grey with a dense patch of long, pale, soft hairs (fig. 9, *d*) on the membrane behind the thoracic spiracle. *Halteres* pale yellow with brown stem.

Abdomen dull black, densely covered with closely applied deep red-brown narrow scales; all segments except the terminal with anterior marginal yellow scales, thinly disposed medially; basal fringe dense, of pale hairs of moderate length. *Spermatheca* (fig. 10, *b*) sub-spherical, strongly chitinised and with a raised reticulated surface; duct unchitinised. *Terminalia* (fig. 11). Eighth sternite with a median, triangular chitinised plate (fig. 12, *d*) bearing a few short stout bristles disposed near the basal angles; these bristles continue beyond the plate along the base of the anterior gonopophyses which terminate medially in a triangular process ending in a spatulate tip and are covered with fine soft setae. *Paraprocts,* large and strongly chitinised with numerous fairly stout setae;

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* This species is closely related to *S. gilvipes* Pom., but differs from it in the male terminalia (the coxite being about twice the length of the style in *ruwenzoriensis*, whereas in *gilvipes* they are about the same) and in the pupal filaments, which are distinctly longer in *ruwenzoriensis* and spread out more suddenly from the base.

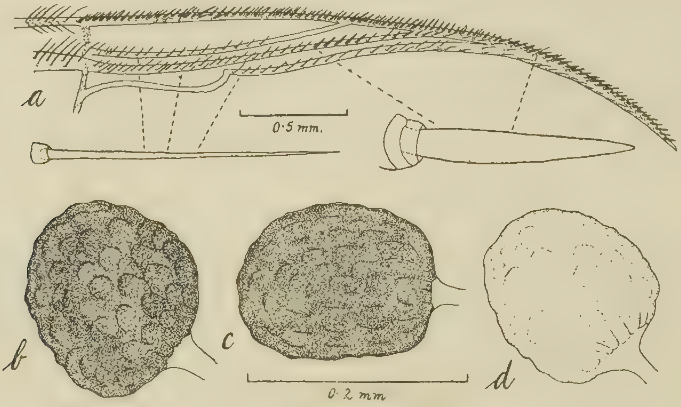

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Fig. 10.—Adult. Anterior portion of wing of female of *S. ruwenzoriensis* showing the distribution of setae (*a*). Spermatheca of *S. ruwenzoriensis* (*b*), *S. dentulosum* (*c*), *S. masabae* (*d*).

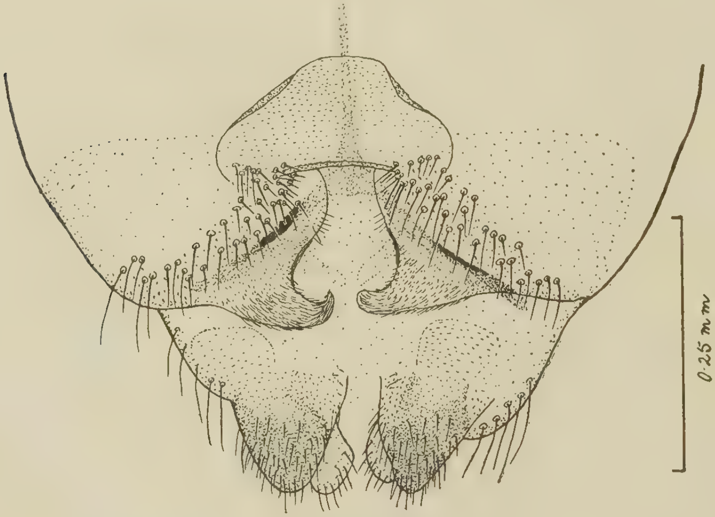

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Fig. 11.—Adult. Female terminalia of *S. ruwenzoriensis* in ventral aspect showing position of sternal plate.

in lateral aspect (fig. 13, *d*) the large triangular ventral process is seen. The cerci are rounded anteriorly.

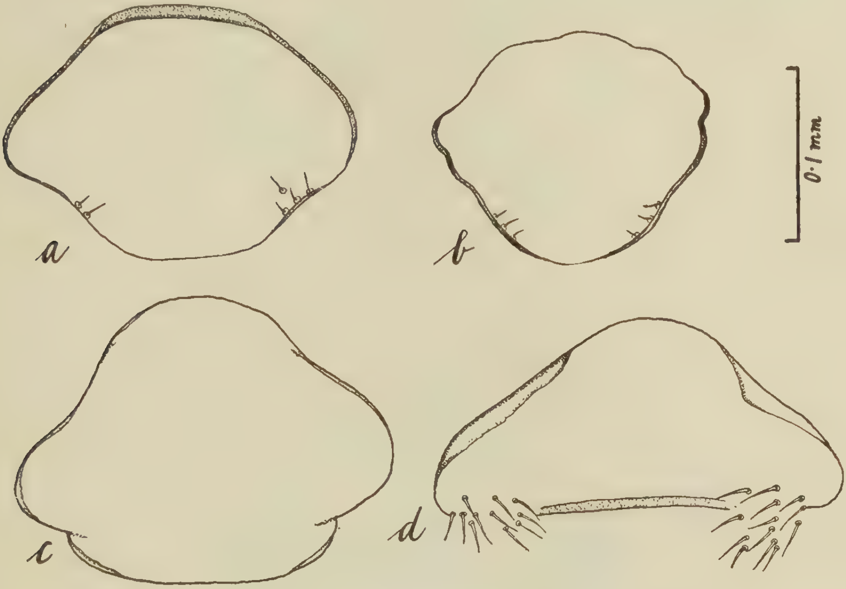

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FIG. 12.—Adult. Sternal plate of female, *S. dentulosum* (*a*), *S. masabae* (*b*), *S. nili* (*c*), *S. ruwenzoriensis* (*d*).

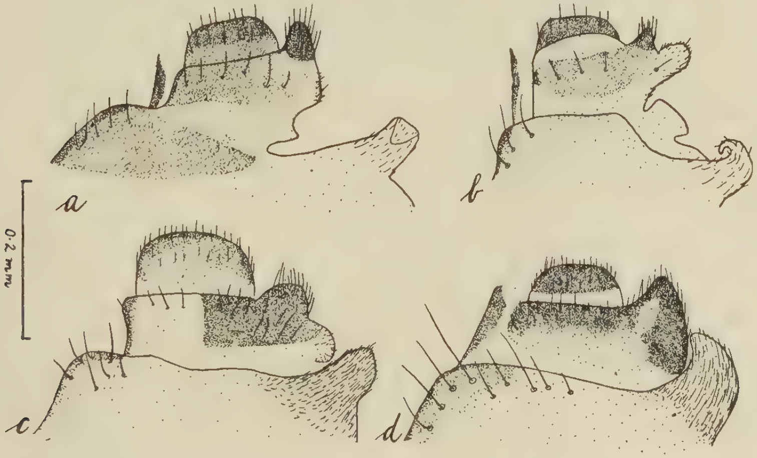

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FIG. 13.—Adult. Paraprocts and cercus of female in lateral view, *S. masabae* (*a*), *S. dentulosum* (*b*), *S. nili* (*c*), *S. ruwenzoriensis* (*d*).

Legs dark brown. Coxae, trochanters, femora and basal two-thirds of tibiae with long narrow yellow scales. Tarsal segments with a pair of long, dark, apical hairs; basal two-thirds of hind first tarsal segment pale except for a narrow dark posterior stripe.

Wings (fig. 10, *a*) without basal cell; subcosta and base of radius with dark hairs; *Rs* simple; Cu_2 with a distinct double bend.

Male. Length 3 mm.; wing 3·1 mm.

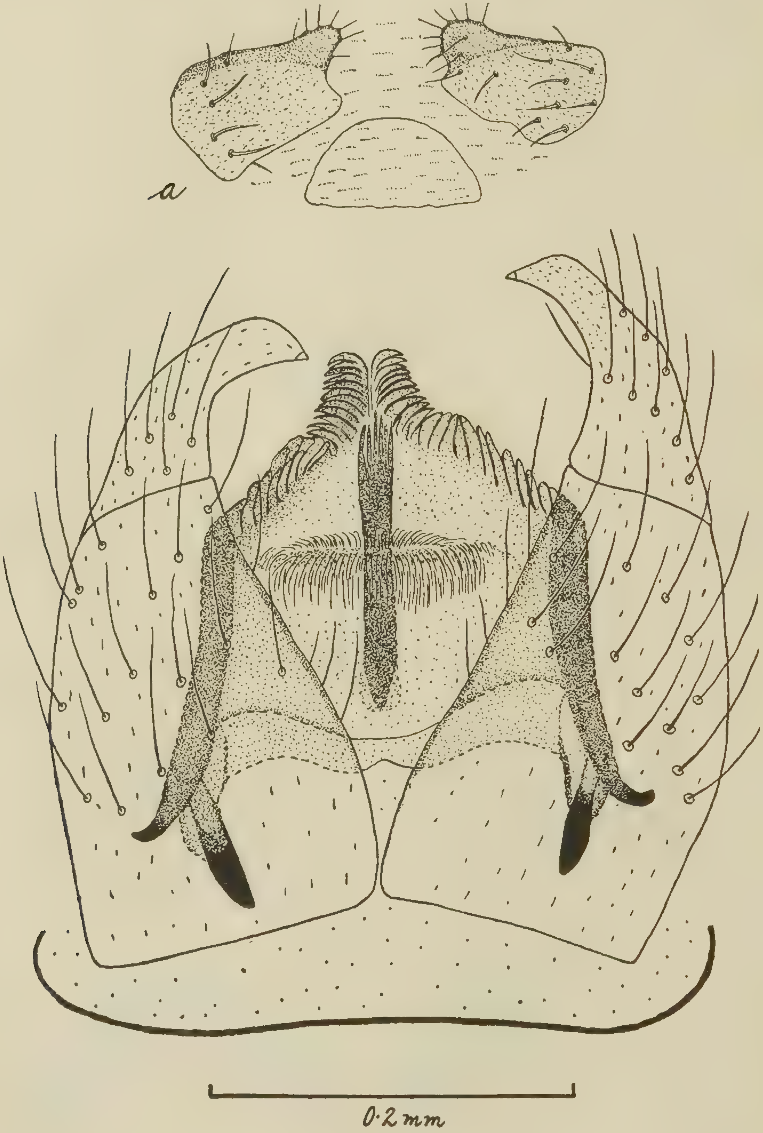

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Fig. 14.—Adult. Male terminalia of *S. ruwenzoriensis* in ventral aspect, cerci and tenth segment (*a*).

Head. Front and *clypeus* dull slate-grey, the former bare of setae and the latter with long brown hairs. *Antenna* as in female but with long dark brown basal hairs.

Thorax. Integument of mesonotum velvet-black, with narrow golden scales disposed thickly posteriorly and laterally and thinly anteriorly and with sparse short dark brown scales in the sub-median areas. *Scutellum* densely covered with long golden scales and long marginal hairs. *Pleura* and *halteres* as in female.

Abdomen velvet-black, basal segments sparsely covered with golden scales which are disposed rather more thickly laterally than dorsally; basal fringe of dense long pale hairs. *Terminalia* (fig. 14). Coxites with long bristles and about twice the length of the styles and at the apex rather more than twice their basal width. The styles, which are of similar width to the coxites basally bear long setae, narrow suddenly in the anterior fifth and terminate in a short, stout tooth. Intercoxal piece broad, with fine setae anteriorly and with two basal strongly chitinised dagger-like processes. Mesosome broad, serrated anteriorly, with an extremely narrow genital opening and with a thumb-like basal process. Median process strongly chitinised, large and cylindrical, serrated apically. Cerci (fig. 14, *a*) constricted distally and with short stout setae. Tenth segment as figured.

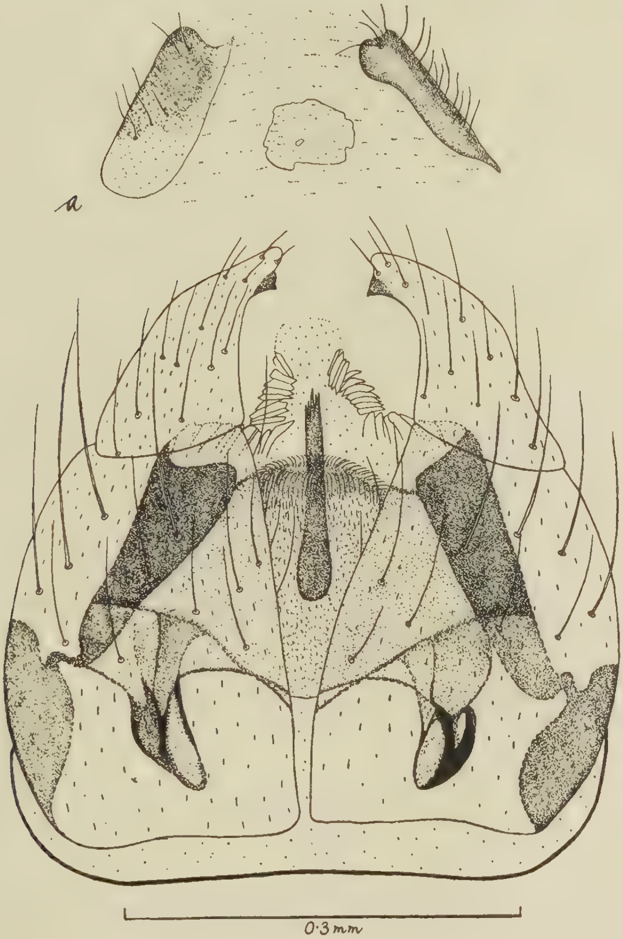

FIG. 15.—Adult. Male terminalia of *S. nili* in ventral aspect, cerci and tenth segment (*a*).

Legs dark brown with long dark hairs; coxae with long pale hairs; tibiae basally pale; front femora outwardly pale; hind legs with tibiae and first tarsal segment large and swollen sub-apically.

Wings as in ♀.

Holotype, ♀, Bwamba Pass, 5,000–7,000 ft., Toro, 6.i.32.
Allotype, ♂, same data.
Paratypes, 10 ♀♀, 16 ♂♂ with types.
Reared from pupae.
Two females taken on man, Mitandi, 6,000 ft., Toro, 20.ii.32.

Larva. Length of mature larva 9·1 mm. General colour black, body without scales or spines.

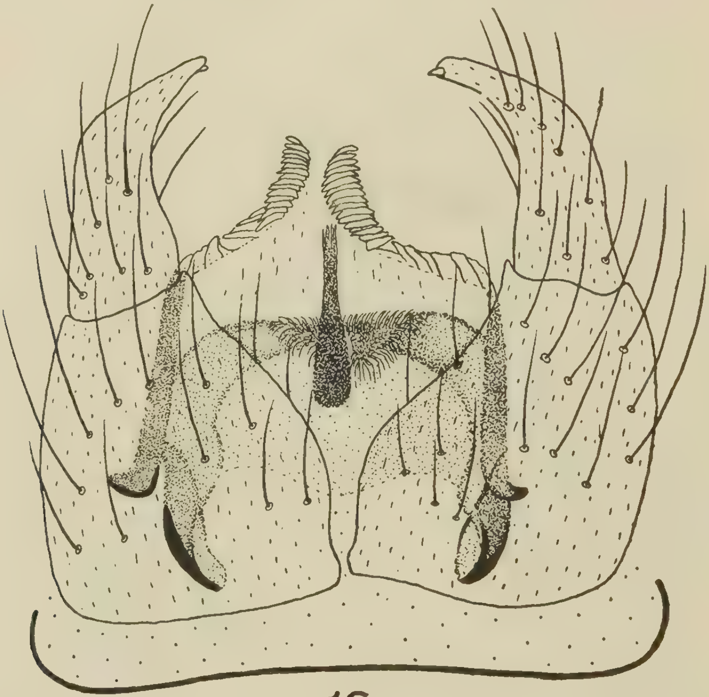

FIG. 16.—Adult. Male terminalia of *S. masabae* in ventral aspect. Paraprocts and cerci as in *S. ruwenzoriensis*. (Magnification as in fig. 9.)

Head. Front (fig. 18, *f*) with three groups of pigmented spots, two of which are situated above a lightly chitinised triangular area, and one a little nearer the margin between the median two. *Antenna* (fig. 18, *a*) long and lightly chitinised, consisting of four segments and about 1½ times as long as the base of the feeding-brushes; the second segment, slightly longer than the first (which has a dark lateral pigmented convex area) bears at its distal end two knob-shaped sensory processes, third segment about half as long as the second, fourth consisting of a lightly chitinised cone. *Palp* (fig. 19, *a*) long, crowned with small teeth, bearing laterally six short spines. *Mandible* (fig. 20, *c*) with three large main distal teeth and with nine smaller teeth progressively increasing in size distally protruding from a straight surface. *Mentum* (fig. 21, *a*) with a terminal row of nine strongly chitinised teeth, the median and lateral longer than the rest; on each side there is an oblique row of eighteen stout spines arising from clearly-defined bases and progressively increasing in size distally; three small spines are situated in the sub-median basal areas. *Feeding-brushes* with about 75 bristles.

Thorax. Thoracic patch as in figure 22, *a*. *Pseudopod* long and straight-sided, twice as long above as the distance below the head suture.*

Abdomen. Anal gills consisting of three lobes, each with about eight finger-like secondary processes. *Anal armature* as in figure 23, *b*. *Anal sucker* with about 280 rows each containing 40–50 hooks.

Pupa. Head and *thorax* with small disc-like tubercles and simple trichomes (fig. 26, *b*) which are of moderate length and slender. *Respiratory organ* (fig. 24, *a*) dark, consisting of fourteen strong filaments which arise from seven main stems, branch dichotomously a short distance from the base and terminate in a heavily chitinised, pointed, black apex. Under high magnification the outer wall (fig. 24, *e*) is seen to be covered with minute pigmented circular nodules which are arranged in rows over the entire surface with the exception of the base (fig. 24, *d*) and tip.

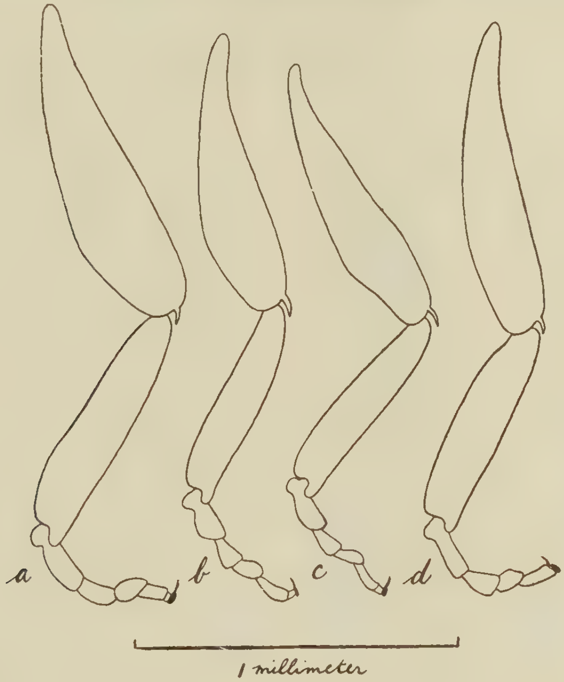

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Fig. 17.—Adult. Hind legs of male, *S. ruwenzoriensis* (*a*), *S. dentulosum* (*b*), *S. masabae* (*c*), *S. nili* (*d*).

Abdomen. Dorso-lateral surface : first segment with a row of five short spines and one slender hair (fig. 26, *d*), the outer spine (which is the smaller) and the hair are situated slightly anterior to the rest, the latter between the third and fourth outer spines; second segment with three spines, one small hook and a slender hair, the latter situated between the outer spine and hook; third and fourth segments with four strong hooks (fig. 26, *f*)

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* In this paper the length of the pseudopod is given in comparison to the distance from its basal angle to the head suture.

equally-spaced and with a row of three spicules more widely spaced above; fifth with two spicules (fig. 26, *c*); sixth with a median basal spiculate patch; seventh spiculate basally. *Ventro-lateral surface:* fourth segment spiculate; fifth with two closely-approximated hooks and spiculate basally, sixth and seventh with two widely-spaced hooks.

The *cocoon* (fig. 27, *a* & *b*) is a gelatinous boot-shaped structure about four millimetres in length with a strong double rim and neatly interwoven with fine threads.

Breeding places.

The larvae and pupae of *S. ruwenzoriensis* greatly outnumbered two other species (N1 and N2) * in the River Mpanga at altitudes between 5,000 ft. and 7,000 ft. on the Ruwenzori foothills in the Bwamba Pass. They were found in large numbers in the shaded parts of the stream a yard or so below cascades but never actually in the falls, attached to clean loose stones of all sizes lying on the river bed, and clean slender tree roots dipping into the swiftly-flowing water which was about one foot deep. Adults were caught on the wing, flying in an orchard at Mitandi, Toro, at 6,000 ft. above sea-level. They were not observed to bite but were most annoying owing to their habit of flying round the head, alighting on the face, and getting into the eyes.

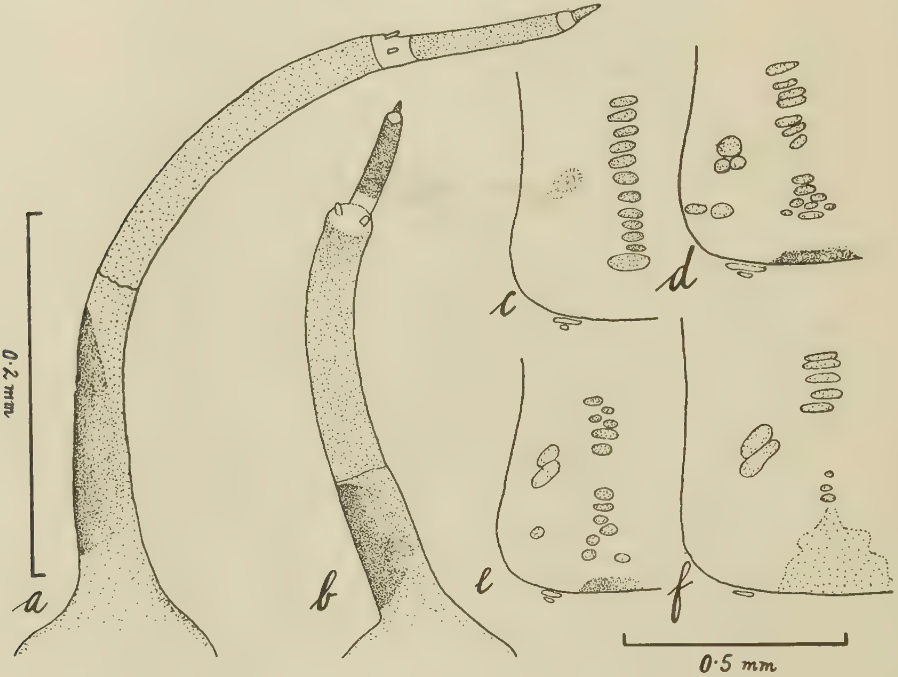

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FIG. 18.—Larva. Antenna in lateral aspect, *S. ruwenzoriensis* (*a*), *S. nili* (*b*), part of front showing pigmented areas in *S. dentulosum* (*c*), *S. nili* (*d*), *S. masabae* (*e*), *S. ruwenzoriensis* (*f*).

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* Species referred to in this manner are those in my collection which have not yet been determined.

Simulium dentulosum Roub.*

Female. Length 3·5 mm.; wing 3·7 mm.

In general appearance darker than *S. ruwenzoriensis.*

Head. Vertex and *front* as in *ruwenzoriensis* excepting that there are fewer scales. *Clypeus* light grey with long pale hairs.

Thorax. Scutellum, pleura, and *halteres* as in *ruwenzoriensis. Mesonotum* as in *ruwenzoriensis,* but with sparse black scales dorsally.

Abdomen as in *ruwenzoriensis* except that the basal segments have fewer dark scales and are somewhat shiny. *Spermatheca* (fig. 10, *c*) barrel-shaped, strongly chitinised and with a raised reticulated surface. *Terminalia* similar in general appearance to that of *ruwenzoriensis,* but differing in the shape of the plate on the eighth sternite (fig. 12, *a*) and in the paraprocts (fig. 13, *a*), which in lateral view are seen to broaden more gradually anteriorly than in *ruwenzoriensis* into the triangular ventral process.

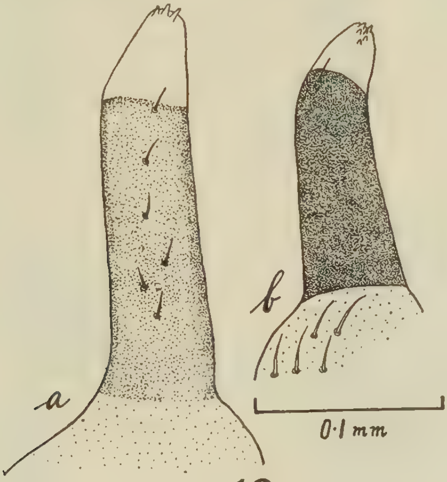

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FIG. 19.—Larva. Palp in lateral aspect, *S. ruwenzoriensis* (*a*), *S. dentulosum* (*b*).

Legs and claws as in *ruwenzoriensis.*

Wings as in *ruwenzoriensis.*

Male. Length 2·6 mm.; wing 3·1 mm.

Similar to *ruwenzoriensis* in external characters and terminalia, but differing slightly in the shape and length of the tarsi of the hind legs. The first tarsal segment (fig. 17, *b*) is not so markedly swollen sub-apically and the second is rather short and about equal in length to the fifth, whereas in *ruwenzoriensis* this segment is relatively longer.

Neallotype, male, Lule 6,000 ft., Mt. Nkokonjeru, 1.iv.32.

19 ♀♀, 12 ♂♂, with neallotype; 9 ♀♀, 9 ♂♂, Sipi, 7,000 ft., Mt. Elgon, 3.iv.32; 2 ♀♀, 1 ♂, R. Sasa 9,500 ft., Mt. Elgon, 6.iv.32.

All reared from pupae.

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* The type, presented to the British Museum by Dr. S. A. Neave, is a female and was captured at the Siroko River near the foot of Mt. Elgon, 3,600 ft. above sea-level. Some of the writer's material came from the same mountain but from a higher altitude (7,000–9,000 ft.); these specimens were reared from pupae, while in a personal communication Dr. Neave informs me that his examples were obtained as adults. When compared with the type the female terminalia proved indistinguishable.

Larva. Length of mature larva 10·3 mm. General colour and absence of body scales and spines as in *ruwenzoriensis.*

Head. Front (fig. 18, *c*) with a median row of about twelve pigmented spots and a single isolated spot situated near the margin. *Antenna* as in *ruwenzoriensis* (fig. 18, *a*). *Palp* (fig. 19, *b*) short and strongly chitinised, with the exception of the base, which bears several spines, and the distal end. *Mandible* (fig. 20, *b*) with a main flat-headed, anvil-shape tooth, and with nine smaller teeth protruding from its concave surface. *Mentum* (fig. 21, *c*), apart from slight differences in the terminal teeth and fewer lateral spines (about 12) closely resembling that of *ruwenzoriensis. Feeding brushes* as in *ruwenzoriensis.*

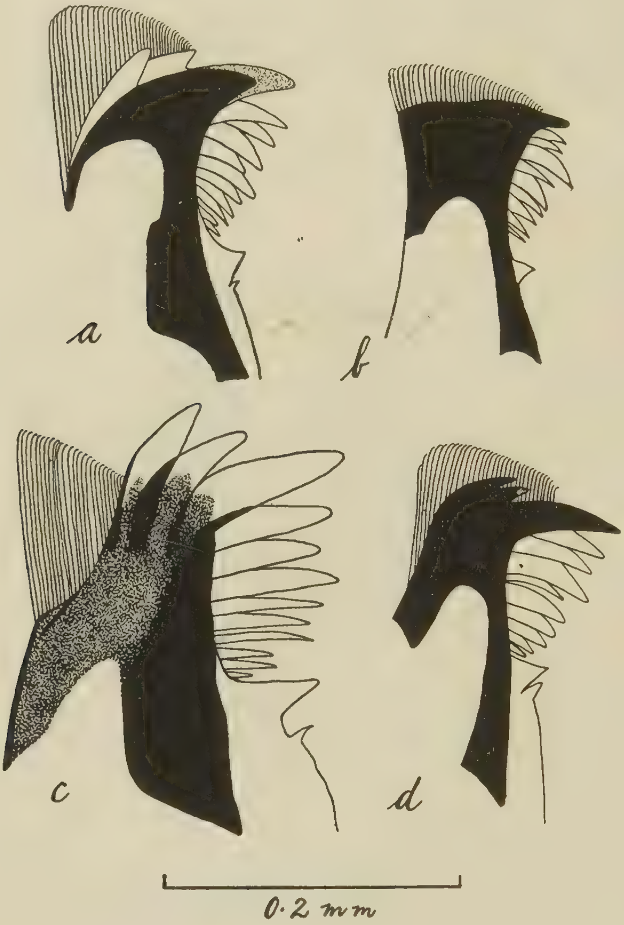

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Fig. 20.—Larva. Mandible, *S. nili* (*a*), *S. dentulosum* (*b*), *S. ruwenzoriensis* (*c*), *S. masabae* (*d*).

Thorax. Thoracic patch as in figure 22, *d*. *Pseudopod* short, distal end situated but little anterior to the head suture.

Abdomen. Anal gills trilobed, the median and lateral lobes each with one large and seven and five small finger-like processes respectively. *Anal armature* as in *ruwenzoriensis* (fig. 23, *b*). *Anal sucker* with about 210 rows each containing 50–60 hooks.

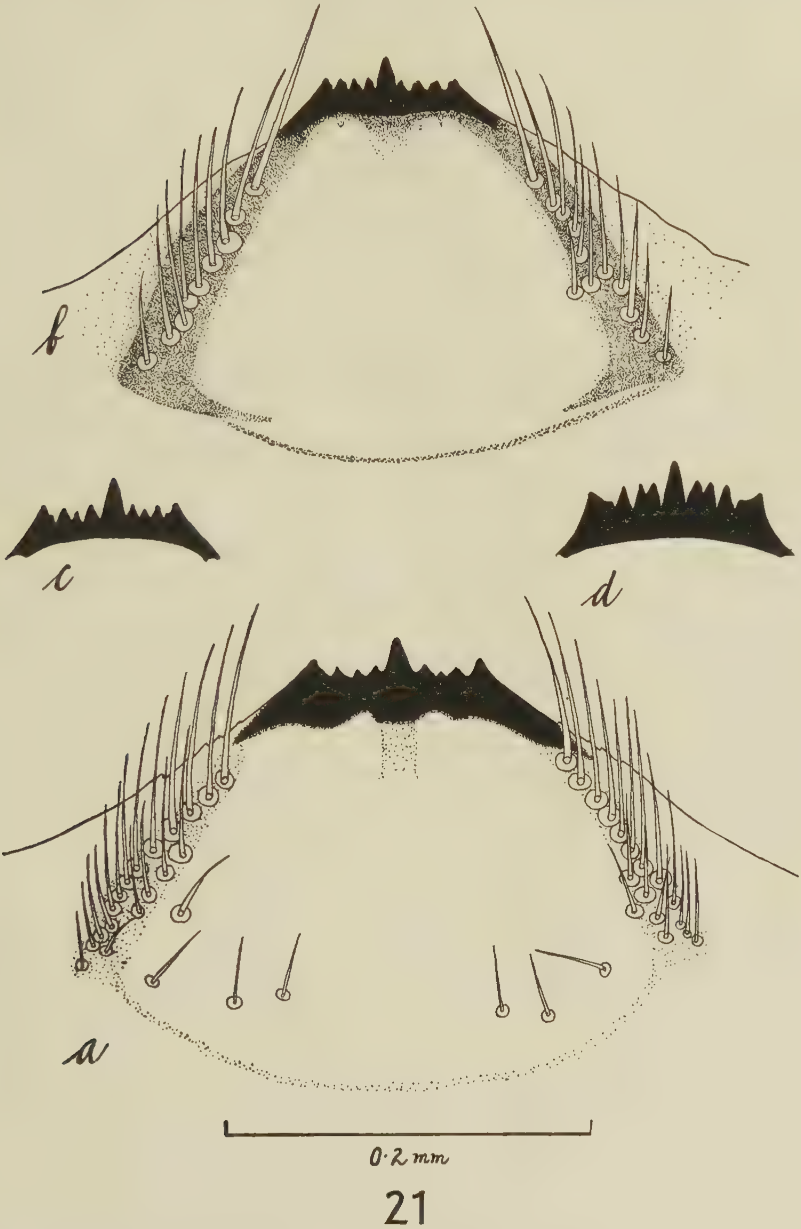

FIG. 21.—Larva. Mentum, *S. ruwenzoriensis* (*a*), *S. nili* (*b*), terminal teeth of same in *S. dentulosum* (*c*), and *S. masabae* (*d*).

Pupa. Head and *thorax* as in *ruwenzoriensis. Respiratory organ* (fig. 24, *b*). Filaments similar in number and sculpture of the outer wall to those of *ruwenzoriensis.* From a comparatively narrow base arise four stems and one arm, which continues laterally and divides into two stems and one terminal stem; each again dividing into paired filaments, the distal being considerably shorter than the rest. In their natural position the filaments lie well above the top of the cocoon and it was this constant feature which first directed attention to this species.

Abdomen. Dorso-lateral surface: first segment with three short spines; second with four short spines, one slender hair and one spicule which lie near and anterior to the outer spine; third, sixth and ninth spiculate basally, and the former with four strong hooks; fourth with four strong hooks. *Ventro-lateral surface:* sixth, seventh and eighth segments with two curved hooks, those on the former closely-approximated; seventh and eighth spiculate basally.

The *cocoon* (fig. 28, *c* & *d*) is slipper-shaped, about four millimetres in length, and of similar structure to that of *ruwenzoriensis.*

Breeding places.

The early stages of *S. dentulosum* and *S. masabae* were found in the River Naboinga near Bumboi (6,000 ft.), the River Nabigwo near Lule (6,300 ft.), and the River Kyagodo (6,000 ft.), on Mount Nkokonjeru near Mbale; the River Sasa (9,500 ft.) above Bulambuli, the River Sipi (7,000 ft.), and the Rivers Cheptui and Kyebonet at about 6,000 ft. between the rest camps of Sipi and Sabei on the slopes of Mount Elgon in Northern Bugishu. All these mountain streams are extremely rapid flowing; they are a succession of cascades, with long falls at intervals, and the larvae and pupae were found attached to grass blades and stalks and fine tree roots being tossed about in the spray. In the icy-cold water of the River Sasa at 9,500 ft. the larvae and pupae were present attached to threads of an alga-like plant as well as to the fine roots of tree-heather. In the River Naboinga they were breeding in small numbers in association with another species (N14) on the bright green juicy stalks and leaves of a species of Umbellifer, which was growing so profusely in the river near Bumboi that the course of the stream was obscured. At 7,000 ft. in the River Sipi the early stages were found in a depth of three inches of water on the swaying stems and leaves of a *Polygonum* at a point where the water gathers momentum before falling into an abyss below.

Simulium nili sp. n.

Female. Length 3·6 mm.; wing 4·3 mm.

Head. Vertex and *front* slate-grey and thickly covered with silver-grey scales. *Front* of normal width. *Clypeus* slate-grey with short pale hairs. *Antenna* brown and covered with a fine grey pubescence with the exception of the three basal segments which are ochraceous.

Thorax. Integument of mesonotum dull black and covered with closely-applied pale yellow scales which are short in the median area and have a tendency to be longer towards the margins. *Scutellum* covered with long golden scales and marginal hairs. *Pleura* with a patch of soft pale yellow hairs (fig. 9, *b*) on the membrane behind the thoracic spiracle; these hairs are shorter than those of *ruwenzoriensis. Halteres* as in *ruwenzoriensis.*

Abdomen. Lustrous grey-brown covered with pale yellow scales which are more dense laterally; basal fringe sparse of short pale hairs. *Spermatheca* as in *dentulosum* (fig. 10, *c*). *Terminalia:* eighth sternite with a chitinised plate as illustrated in figure 12, *c*. Anterior gonopophyses as in *ruwenzoriensis* (fig. 11). Paraprocts (fig. 13, *c*) with two rounded ventral processes, the anterior of which is strongly chitinised and bears stout setae, the other is unchitinised and spiculate. Cerci large, rounded distally.

Legs golden except for the coxae which are slate-grey and tarsi (except for the hind first tarsal segment which has the basal two-thirds with a broad pale postero-lateral stripe) which are dark brown.

Wings as in *ruwenzoriensis*, but with a basal cell (fig. 9, *a* & *b*) and only about four hairs on the base of the subcosta.

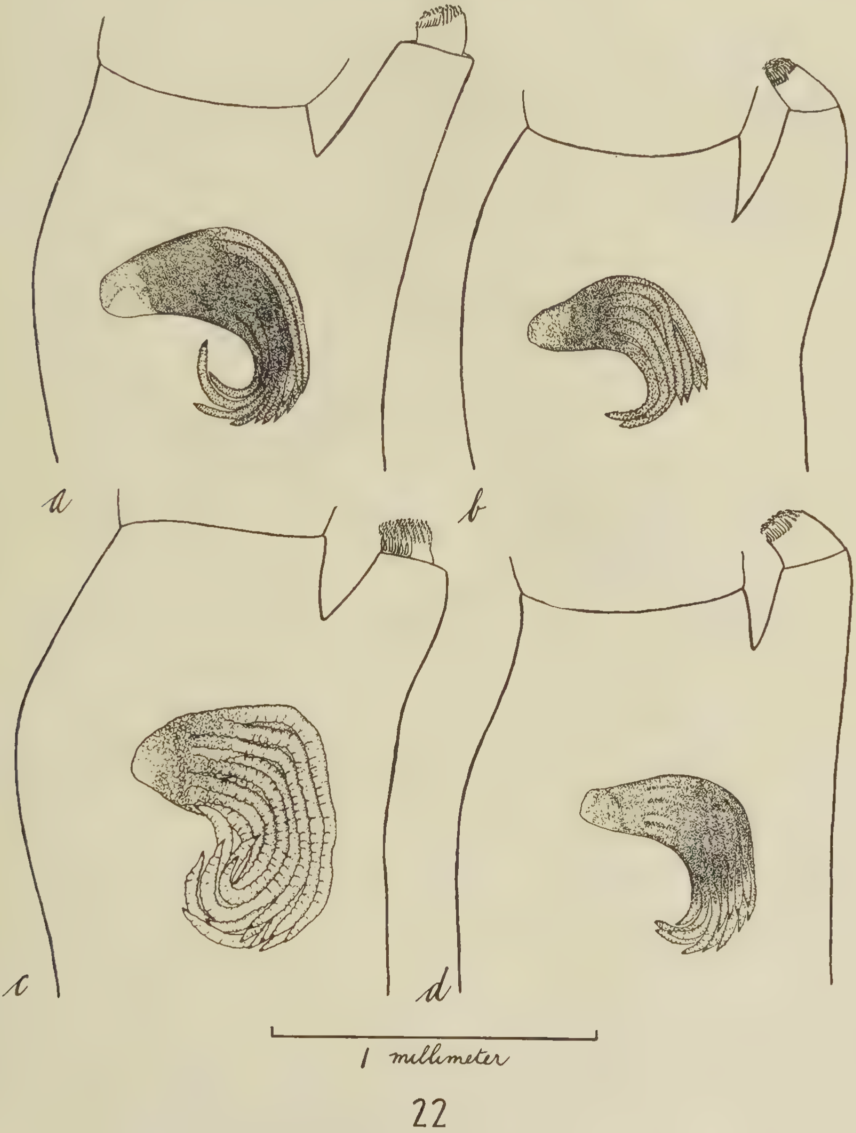

FIG. 22.—Larva. Thoracic patch and pseudopod, *S. ruwenzoriensis* (*a*), *S. masabae* (*b*), *S. nili* (*c*), *S. dentulosum* (*d*).

Male. Length 3·4 mm.; wing 3·2 mm.

Head. *Front* and *clypeus* slate-grey, the latter with long pale hairs. *Antenna* as in female.

Thorax. Integument of mesonotum velvet-black above with slate-grey margins covered with brassy scales which are thinly disposed medially. *Scutellum* black with a slate-grey convex stripe anteriorly covered with long narrow brassy scales and with dark postero-marginal hairs. *Pleura* as in female. *Halteres* as in *ruwenzoriensis.*

Abdomen velvet-black basally, the terminal segments dark brown and sparsely sprinkled with short brassy scales which are denser on the second segment and also laterally where they tend to be longer; basal fringe as in *ruwenzoriensis. Terminalia* (fig. 15): coxites large about 1½ times as long as their maximum width, convex outwardly and with long bristles. Styles with long setae tapering gradually to a rounded tip, and with an inwardly projecting sub-apical triangular chitinised process and a short, stout, terminal tooth. Intercoxal piece broad and similar to that of *ruwenzoriensis,* but differing in that the two basal processes are large and cup-like. Mesosome broad, serrated anteriorly with a wide lateral flap, which is partly folded over so as to enclose the intercoxal piece, and is attached to the coxite at its lower extremity. Median process as in *ruwenzoriensis.* Cerci (fig. 15, *a*) large and rectangular with stout setae. Tenth segment irregular in shape with minute spinules.

Legs dark brown; coxae slate-grey; femora of all legs golden with yellow scales, the hind femora somewhat darker generally and particularly at the apex; tibiae with pale bases.

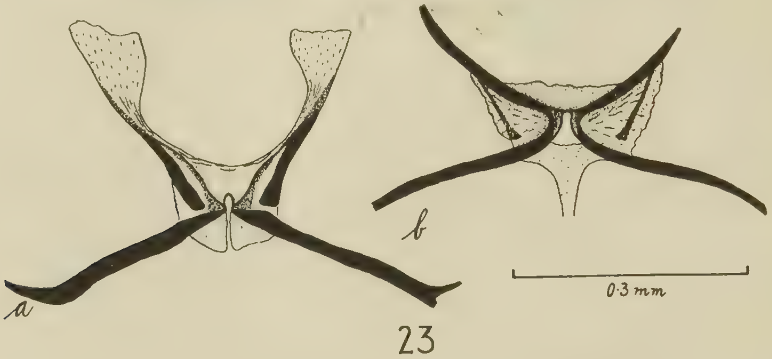

FIG. 23.—Larva. Anal armature, *S. nili* (*a*), *S. ruwenzoriensis* (*b*).

Wings as in ♀.

Holotype, ♀, Jinja (R. Nile), 3,800 ft., 4.iii.32.
Allotype, ♂, same data.
Paratypes with types 19 ♀♀, 28 ♂♂.
All reared from pupae.

Larva. Length of mature larva 11·5 mm. General colour and absence of body scales and spines as in *ruwenzoriensis.*

Head. Front (fig. 18, *d*) with four groups of pigmented spots, three arranged as in *ruwenzoriensis* with an additional group below the sub-median and close to the margin. *Antenna* (fig. 18, *b*) short and rather strongly chitinised, consisting of four segments about three-quarters as long as the base of the feeding-brushes; the second segment twice as long as the first (which has a pigmented convex area somewhat darker than in *ruwenzoriensis*) and bearing at its distal end two knob-shaped sensory processes, third distinctly shorter than the first and more strongly chitinised than the rest, fourth consisting of an inconspicuous cone. *Palp* as in *dentulosum* (fig. 19, *b*). *Mandible* (fig. 20, *a*) with a main strongly chitinised tooth, which is less heavily chitinised at the tip, and with twelve smaller teeth, ten of which protrude from its concave side and two from its distal end. *Mentum* (fig. 21, *b*) with a terminal row of nine strongly chitinised teeth, all except the median (which is longer than the rest) with a shoulder on their edge; an oblique row of nine to twelve stout spines with clearly defined bases lie on a pigmented area on either side. *Feeding-brushes* with about 50 bristles.

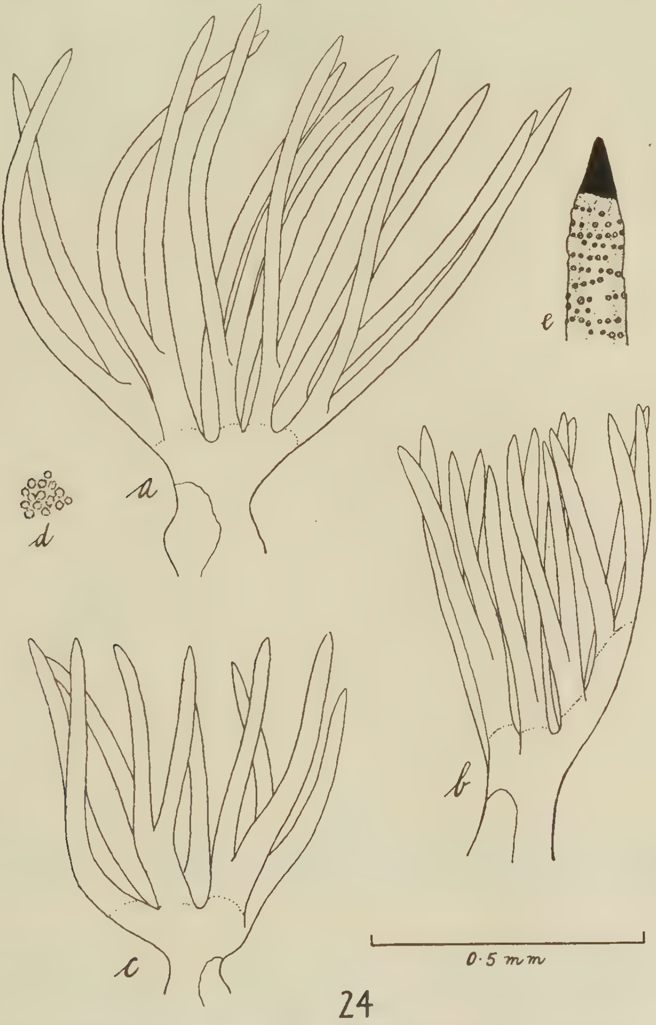

FIG. 24.—Pupa. Respiratory organ of *S. ruwenzoriensis* (*a*), *S. dentulosum* (*b*), and *S. masabae* (*c*). Base of filament highly magnified (*d*) and apex (*e*).

Thorax. Thoracic patch as in figure 22, *c*. *Pseudopod* short, situated on about the same level as the head suture.

Abdomen. Anal gills trilobed, the median with sixteen secondary finger-like processes and the lateral with eight of varying length. *Anal armature* as in figure 18, *a*. *Anal sucker* with about 130 rows each consisting of 20–30 hooks.

Pupa. Head and *thorax* with trichomes the same, and minute tubercles smaller than those of *ruwenzoriensis*. *Respiratory organ* (fig. 25) light brown and semi-translucent consisting of fourteen strong filaments which branch similarly to those of *ruwenzoriensis*, but differ in that the stems spread out widely near the base. The difference in the sculpture of the outer wall (fig. 25, *a*) is marked and under high magnification the absence of pigmented nodules is apparent.

Abdomen. Dorso-lateral surface : first segment as in *ruwenzoriensis*; second and third spiculate basally with four equally-spaced hooks and two spicules (fig. 26, *e*), one on the outer edge and one slightly above and between the outer two hooks; fourth, fifth, sixth and seventh spiculate basally (fig. 26, *a*), the fourth and fifth with a row of five spicules, the outer of which is a little anterior to the rest, the sixth with three spicules and the seventh with one; eighth segment with inwardly curved hooks. *Ventro-lateral surface :* fourth segment spiculate medially and with a row of five larger spicules, the outer two a little above the rest; fifth spiculate basally with two closely-approximated hooks and one spicule above the outer hook; sixth and seventh spiculate basally with two widely separated hooks; eighth spiculate.

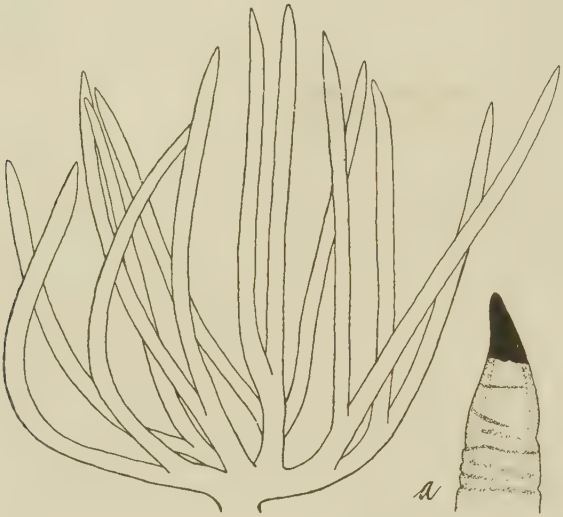

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Fig. 25.—Pupa. Respiratory organ of *S. nili*; apex highly magnified (*a*) (magnification same as fig. 24).

The *cocoon* (fig. 27, *c* & *d*) is a coarsely woven boot-shaped structure varying between five and six millimetres in length.

Breeding places.

The early stages were found in the River Nile near Jinja. The larvae were huddled together in large black masses in slight depressions and crevices on the vertical side of slimy rock over which the water dashed at great speed. In this situation the insect, while obtaining the full benefit of the highly aerated water, was subjected to the minimum amount of inconvenience and was apparently rarely dislodged. The habitat being rich in organic matter, they did not appear to travel far in search of food, and pupated on top of one another and on the pupae of other aquatic insects amongst active larvae of their own species.

Simulium masabae * sp. n.

Female. Length 2·1 mm.; wing 3·3 mm.

Head. *Vertex* and *front* slate-grey, with a few golden scales interspersed with black hairs; front of normal width. *Clypeus* of similar colour and with long dark hairs. *Antenna* dark brown with fine grey pubescence with the exception of the scape and basal flagellar segment which are lighter.

Thorax. Integument of mesonotum black with golden scales on the margins and smaller brassy scales sparsely sprinkled in patches dorsally. *Scutellum* sparsely covered with golden scales and with long postero-marginal hairs. *Pleura* with a patch of soft golden hairs. *Halteres* as in *ruwenzoriensis.*

Abdomen dull black with golden scales sparse dorsally and dense laterally; basal fringe sparse of short yellow hairs. *Spermatheca* (fig. 10, *d*) sub-spherical, lightly chitinised, and finely reticulated. *Terminalia:* eighth sternite with a plate as illustrated in figure 12, *b*. Anterior gonopophyses as in *ruwenzoriensis* (fig. 11). Paraprocts (fig. 13, *b*) with two rounded ventral processes, the anterior of which is chitinised and carries many bristles, while the posterior is unchitinised and spiculate. Cerci flattened distally.

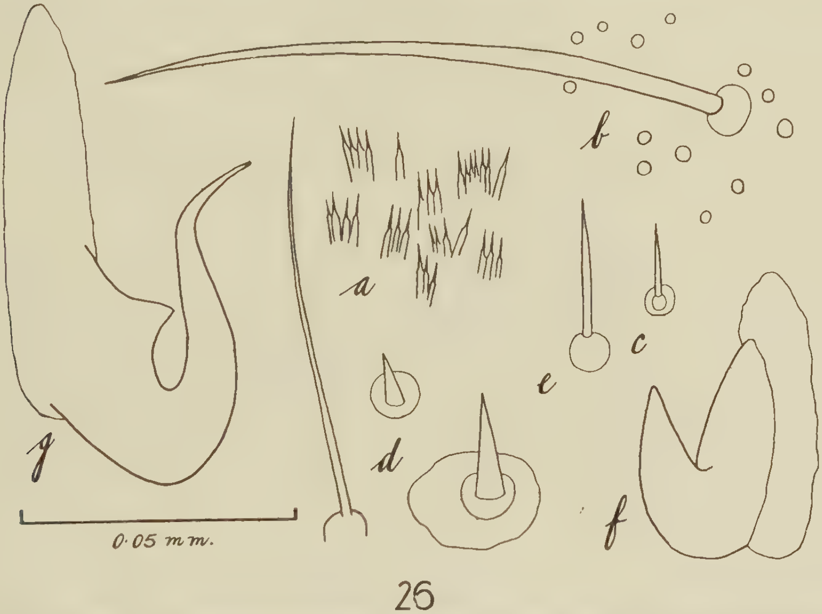

Fig. 26.—Pupa. Abdominal chaetotaxy; spiculate dorsal area (*a*), tubercles and trichome of *S. ruwenzoriensis* (*b*), spicule of 5th tergite of *S. ruwenzoriensis* (*c*), outer spines and slender hair of 1st tergite of *S. ruwenzoriensis* (*d*), spicule of 3rd tergite of *S. nili* (*e*), hook of 4th tergite of *S. ruwenzoriensis* (*f*), hook of 7th tergite of *S. masabae* (*g*).

Legs brown. Coxae and trochanters slate-blue with yellow scales; femora and basal two-thirds of tibiae with yellow scales. Hind legs with first tarsal segment sprinkled with yellow scales. Claws with a rather pointed basal tooth.

Wings as in *ruwenzoriensis,* but with a basal cell.

Male. Length 2·3 mm.; wing 2·8 mm.

Smaller and darker than the other three species dealt with here.

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* From the native name for Mount Elgon "Masaba."

Head. *Front* and *clypeus* slate-grey with long dark hairs. *Antenna* dark brown with grey pubescence.

Thorax. Integument of mesonotum velvet-black, sprinkled with dark brown scales dorsally and golden scales anteriorly and laterally (where they are disposed more thickly) and long pale yellow scales on a light grey posterior patch. *Scutellum* with long pale

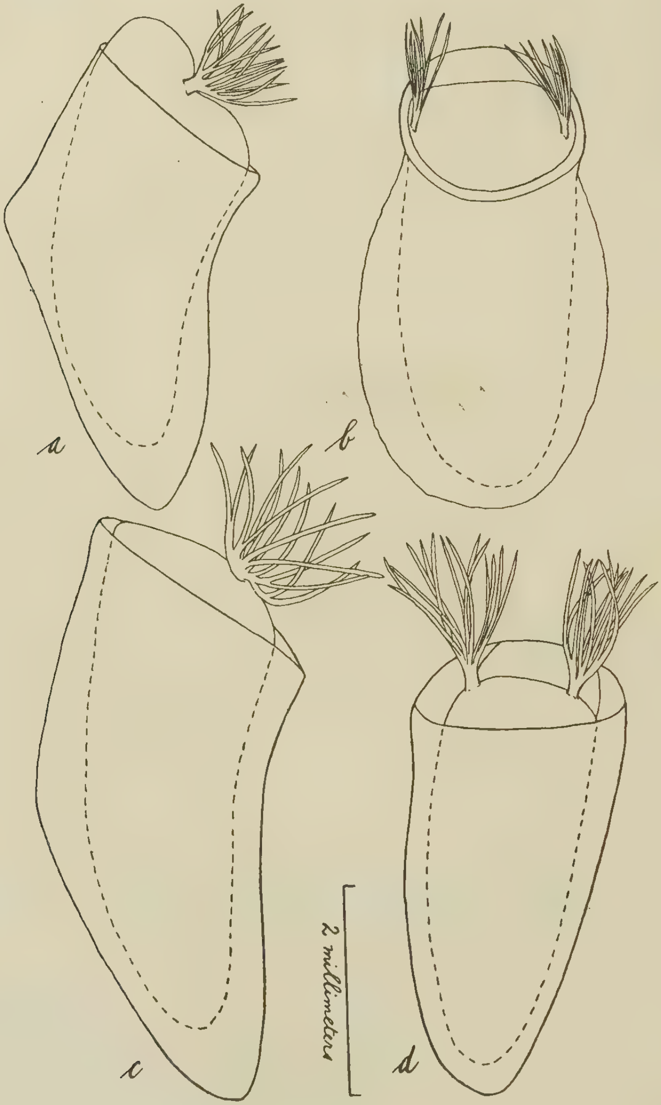

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FIG. 27.—Cocoon with pupa inside showing the natural position of the respiratory organ: *S. ruwenzoriensis* lateral view (*a*), ventral view (*b*); *S. nili* lateral view (*c*), ventral view (*d*).

yellow and dark hairs interspersed. *Pleura* with a patch of long yellow soft hairs. *Halteres* dark brown with pale tips.

Abdomen velvet-black with sparse brown scales; fifth and sixth segments with a lateral slate-grey patch covered with yellow scales; basal fringe with long pale hairs. *Terminalia* (fig. 16): coxites slightly longer than the styles. The coxite is concave inwardly, broad at the base, bears long bristles, and tapers from the posterior third to about half its maximum width apically. Style with long bristles, equal in width at the base to the apex of the coxite, tapering to a rounded tip with a short stout, sub-apical tooth. Intercoxal piece resembling that of *nili* and the mesosome that of *ruwenzoriensis* excepting that it has a wider genital opening. Median process, cerci and tenth segment as in *ruwenzoriensis*.

Legs dark brown. Coxae with pale yellow scales; front femora with pale scales interspersed with long dark hairs basally; tibiae with the basal two-thirds outwardly silver-grey; mid tibiae with the basal half pale; hind tibiae with the basal third outwardly pale; tarsi of all legs with long apical hairs.

Holotype, ♀, Lule, 6,000 ft., Mt. Nkokonjeru, 1.iv.32.

Allotype, ♂, same data.

Paratypes, 15 ♀♀, 24 ♂♂, with types; 9 ♀♀, 14 ♂♂, Sipi, 7,000 ft., 3.v.32; 7 ♀♀, 5 ♂♂, R. Sasa, 9,500 ft.

All reared from pupae.

Larva. Length of mature larva 8·7 mm. General colour and absence of scales and spines as in *ruwenzoriensis*.

Head. *Front* (fig. 18, *e*) with groups of pigmented spots arranged as in *nili* with the exception of the lower marginal group which consists of a single instead of two spots. *Antenna* and *feeding-brushes* as in *ruwenzoriensis*. *Palp* as in *nili* (fig. 19, *b*). *Mandible* (fig. 20, *d*) with one main and two strongly chitinised secondary teeth situated distally and nine teeth protruding from its concave surface. *Mentum* (fig. 21, *d*) with a terminal row of nine strongly chitinised teeth, the median the longest, the outer large with a definite inner shoulder and those immediately on each side of the median tooth placed very close together.

Thorax. *Thoracic patch* as in figure 22, *b*. *Pseudopod* long and slightly curved inwardly, the distal end situated anterior to the head suture.

Abdomen. *Anal gills* trilobed, median with eight and the lateral with six finger-like processes. *Anal armature* as in *ruwenzoriensis* (fig. 23, *b*). *Anal sucker* with about 240 rows, each containing 50–60 hooks.

Pupa. *Head* and *thorax* as in *ruwenzoriensis*. *Respiratory organ* (fig. 24, *c*) with the outer wall exactly as in *ruwenzoriensis*. The ten filaments, which are shorter than those of *ruwenzoriensis*, arise from five main stems out of a comparatively broad base and stand in an almost vertical position.

Abdomen. *Dorso-lateral surface :* first segment as in *ruwenzoriensis*, but without the slender hair; second and third spiculate basally with four equally spaced hooks and two spicules, one on the outer edge and one slightly above and between the outer hooks; fourth, fifth and sixth spiculate basally and with a row of three widely-spaced larger spicules above; eighth strongly spiculate on a chitinised area apically, basally less strongly spiculate and unchitinised, with a row of two larger spicules. *Ventro-lateral surface :* fourth segment spiculate medially; fifth with two closely-approximated hooks and spiculate basally; sixth and seventh with two widely separated hooks (fig. 26, *g*) which have a pronounced basal projection and long tapering distal end; eighth spiculate.

The *cocoon* (fig. 27, *a* & *b*) is finely woven with a maximum length of about four millimetres.

Breeding places.

These have already been dealt with under the ~~preceding~~ species.

GROUP OF *Simulium medusaeformis* Pom.

The four closely related species of this group have a pupal respiratory organ of peculiar formation. It consists of several stout, chitinised stems with secondary semi-translucent filaments which are exceedingly slender and fragile and closely resemble those of *S. medusaeformis* Pom. (1920). Characters common to the adults of the group are: the absence of a patch of scales or hairs on the membranous area behind the thoracic spiracle, front tarsi slightly flattened and claws simple in the female, calcipala present and pedisulcus distinct, terminalia of similar structure and wings with the base of the radius hairy.

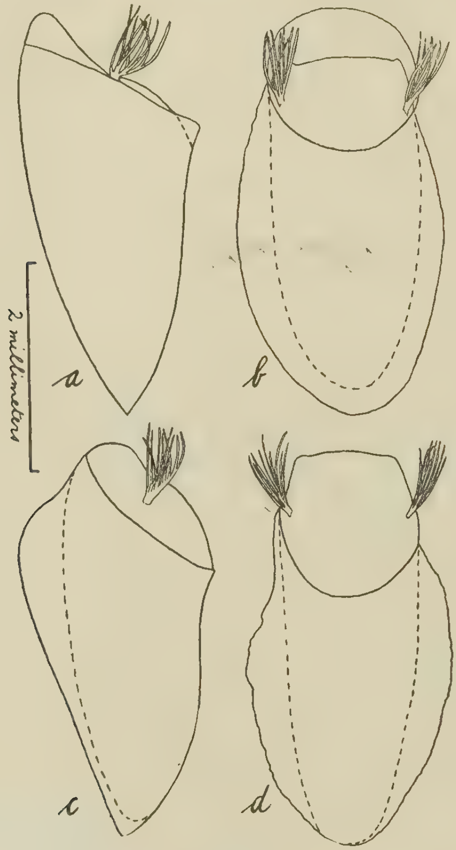

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FIG. 28.—Cocoon with pupa inside showing natural position of respiratory organ: *S. masabae*, lateral view (*a*), ventral view (*b*); *S. dentulosum*, lateral view (*c*), ventral view (*d*).

Simulium hargreavesi sp. n.*

Female. A light coloured species.

Length 2·1 mm.; wing 2·8 mm.

Head. *Vertex, front* and *clypeus* slate-grey, densely covered with narrow silver scales; front of normal width. *Antenna* eleven-segmented, dark brown with the exception of the scape and the two basal flagellar segments which are ochraceous and covered with a fine ash-grey pubescence.

Thorax. Integument of mesonotum slate-grey, uniformly covered with closely-applied silver scales except in the median area where the scales are golden. *Scutellum* with long yellow hairs interspersed with golden scales. *Pleura* light grey, without patch. *Halteres* pale yellow.

Abdomen densely covered with narrow golden scales; basal fringe dense and composed of moderately long pale hairs. *Spermatheca* spherical and strongly chitinised, duct unchitinised. *Terminalia* (fig. 29): eighth sternite with a median chitinised area which is not, however, raised in the form of a plate as in the case of the females dealt with in the previous group; anterior gonopophyses long and tapering almost to a point, with sparse soft setae. In lateral view the paraprocts (fig. 30, *a*) show a narrow process projecting vertically. The cerci are continued into a knob-like projection anteriorly.

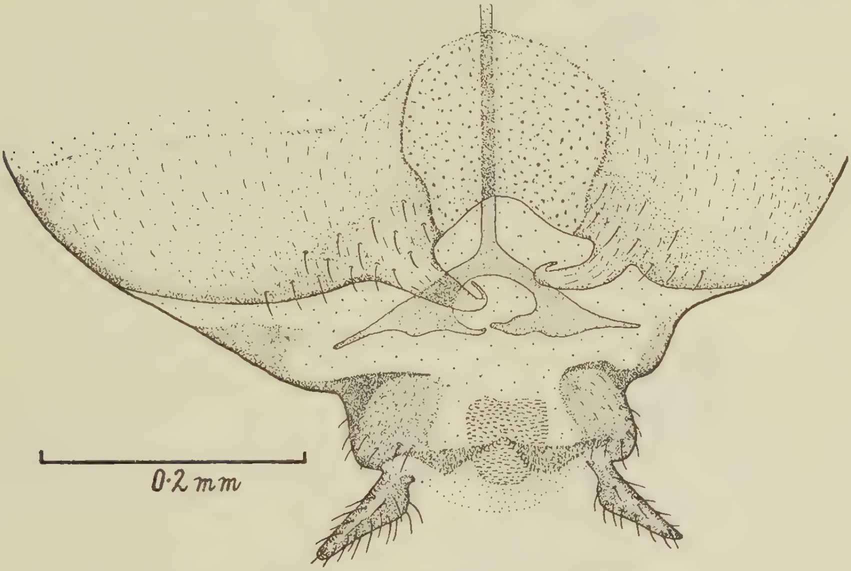

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Fig. 29.—Adult. Female terminalia of *S. hargreavesi* in ventral view.

Legs brown, covered with silvery-yellow scales with the exception of the tarsal segments. Front legs with the basal two-thirds of tibiae markedly pale, tarsi flattened, but not to the same extent as in *S. damnosum* Theo. First hind tarsal segment with pale yellow median band; calcipala rounded anteriorly; pedisulcus distinct; claws without a basal projection.

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* The species is named in honour of Mr. H. Hargreaves, Government Entomologist, Uganda, who first collected the early stages of this Simuliid. The specimens, which the writer was kindly permitted to examine, were obtained in 1924 (1925) and were believed to be those of *S. damnosum* Theo.

Wings pale, without basal cell; costa with hairs and spines; subcosta without hairs excepting for two isolated in the median area; radius with dark hairs at the base; *Rs* simple; Cu_2 with distinct double bend.

Male. Length 2·3 mm.; wing 2·4 mm.

Head. Front and *clypeus* grey, the latter with sparse short hairs. *Antenna* dark brown, scape and basal flagellar segment lighter and covered with a fine grey pubescence.

Thorax. Integument of mesonotum velvet-black, densely covered with brassy scales which appear deeper in colour in the antero-median area. *Scutellum* with brassy scales and long posterior marginal hairs. *Pleura* velvet-grey, patch absent.

Abdomen velvet-black, sparsely covered with yellow scales; basal fringe with long pale hairs; fifth and sixth segments with a dark-grey lateral patch, sparsely covered with long pale hairs. *Terminalia* (fig. 31): coxites with long bristles, and about twice the length of the styles, convex outwardly and wide in the basal third, narrowing gradually to rather more than half their basal width; styles with fine setae and a few bristles basally, rounded anteriorly with a flat sub-apical tooth (fig. 32, *d*). Intercoxal piece narrow apically with two strongly chitinised basal processes, the whole having the appearance of an inverted Y; under higher magnification (fig. 32, *f*) the distal extremity appears knuckle-shaped with an intervening trough bearing fine setae. Mesosome broad, attached to the coxites basally and with numerous conical, spine-like processes of varying length arranged in a semi-circle anteriorly. Median process small and cylindrical. Cerci and tenth segment as in figure 31, *a*.

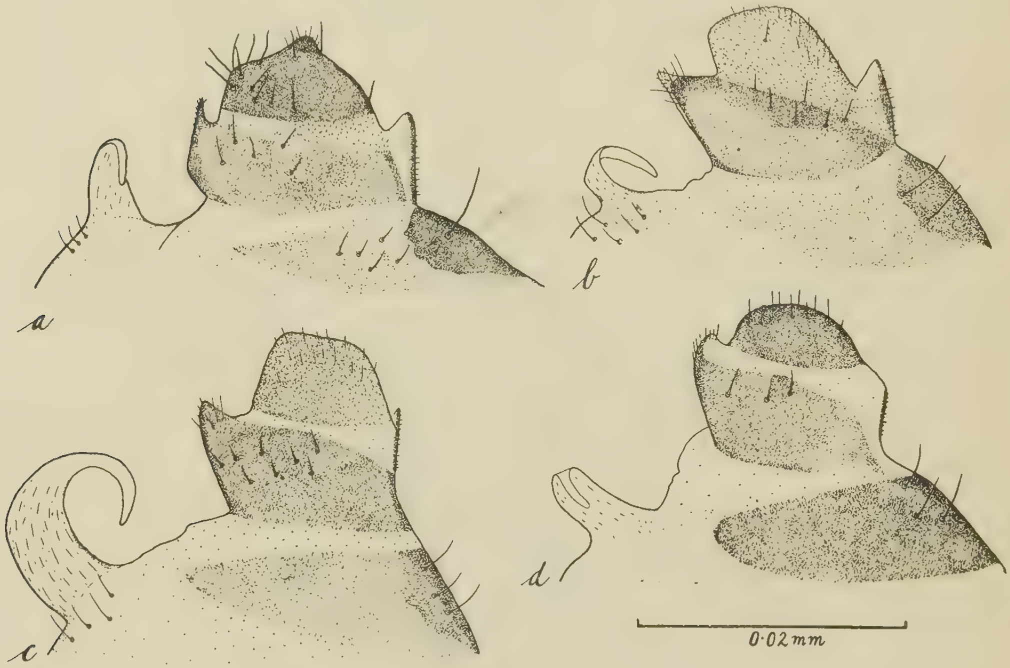

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Fig. 30.—Adult. Paraproct and cercus of female; *S. hargreavesi* (*a*), *S. africanum* (*b*), *S. ugandae* (*c*), *S. elgonensis* (*d*).

Legs dark brown. Coxae, trochanters and femora sprinkled with yellow scales; basal two-thirds of tibiae with yellow scales; first hind tarsal segment with a broad yellow basal band.

Wings as in female excepting that there are several hairs near the base of the subcosta and none medially.

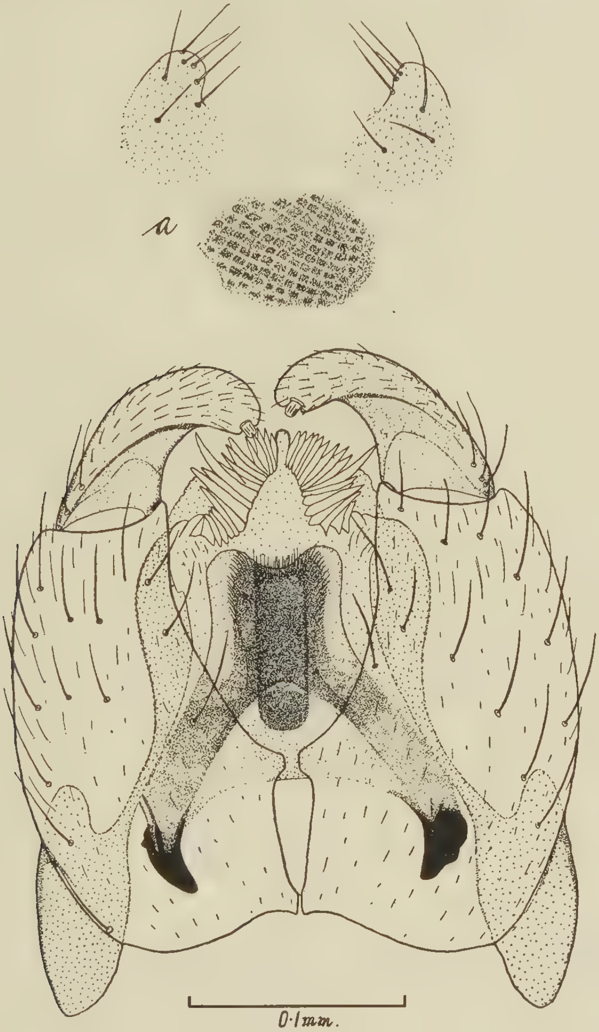

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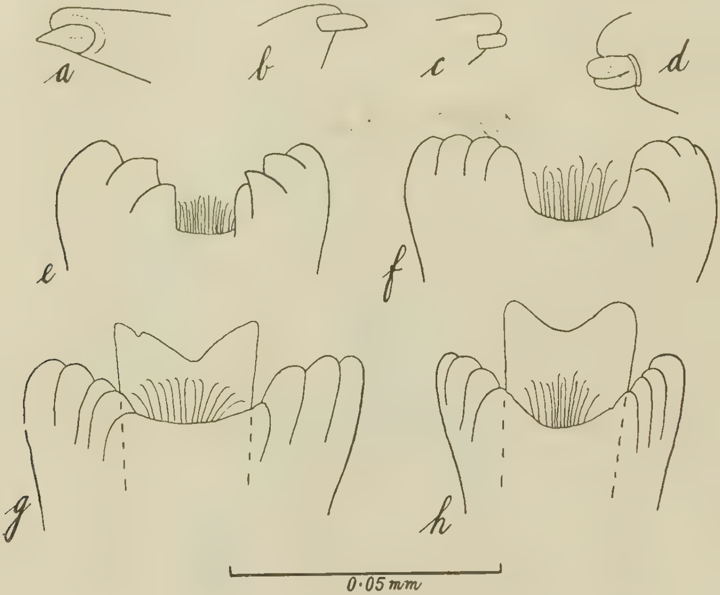
FIG. 31.—Adult. Male terminalia of *S. hargreavesi* in ventral aspect; cercus and tenth segment (*a*).

Holotype, ♀, Jinja (R. Nile), 4.iii.32.
Allotype, ♂, same data.
Paratypes, 44 ♂♂, 43 ♀♀ with types.

Larva. Length of mature larva 6·2 mm. General colour grey in most instances, though some brown specimens were collected. Body sprinkled with narrow scales which are broad at the base and taper to a point (fig. 33, *a*), and with semi-translucent rectal spines.

Head. Front as in figure 34, *d* with somewhat indistinct spots on a pigmented median area. *Antenna* lightly chitinised, about 1½ times as long as the base of the feeding-brushes, and consisting of four segments, the second segment twice as long as the first and bearing at its distal end two unchitinised knob-shaped sensory processes, third about as long as the first, fourth consisting of a small unchitinised cone. *Palp* with the usual curved apical teeth and with a broad median band which is strongly chitinised at the base and of which the degree of pigmentation gradually decreases anteriorly, and with about four long spines arranged obliquely on the unchitinised base. *Mandible* (fig. 35, *d*) with a main strongly chitinised slender tooth and with seven smaller teeth, of which the basal is considerably smaller than the rest, protruding from its concave surface. *Mentum* with the usual terminal row of nine strongly chitinised teeth, the median and lateral longer than the rest; on each side an oblique row of 5–6 spines progressively increasing in size distally and with a single long spine in the sub-median area. *Feeding-brushes* with about twenty long bristles.



32

FIG. 32.—Adult. Male terminalia, sub-apical tooth of style *S. ugandae* (*a*), *S. africanum* (*b*), *S. elgonensis* (*c*), *S. hargreavesi* (*d*). Distal end of intercoxal piece in ventral view; *S. ugandae* (*e*), *S. hargreavesi* (*f*), *S. africanum* (*g*), *S. elgonensis* (*h*).

Thorax. Thoracic patch as in figure 36, *b* with practically no secondary filaments visible. *Pseudopod* conical and about twice as long as its apical width.

Abdomen. Anal gills (fig. 37, *a*) trilobed, each lobe with one main appendage, the median with four and the lateral with five secondary finger-like processes. *Anal armature* as in figure 23, *b*. *Anal sucker* with about 150 rows each containing 30–35 hooks.

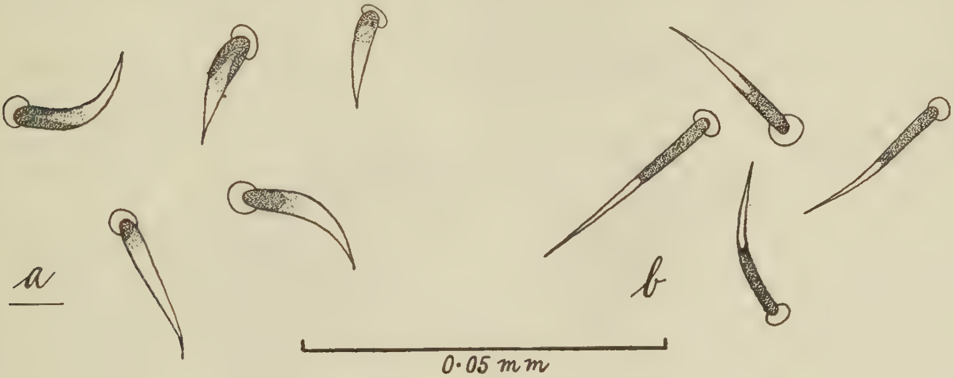
Pupa. Head and *thorax* with disc-like tubercles and simple trichomes which are moderately long and slender. *Respiratory organ* (fig. 38, *a*) band-like, consisting of three strongly chitinised finger-like lobes (which under high magnification with a good light and by careful focussing have the fine striated appearance shown in figure 39, *d*), the median of which is bifid, and two caudal appendages with 18 uniformly slender semi-translucent secondary filaments arising from the ventral surface. The filaments are disposed as follows: eight on the median lobe, four paired and situated at the base, four arranged singly, two one above the other on each arm of the fork; six on the two outer lobes, two in the median areas and one additional pair near the base of the outer lobe proximal to the median; four on the caudal appendages, one near the base of the shorter and three (two of which are paired and arise from a single broad stem) near the base of the longer.

Abdomen. Dorso-lateral and ventro-lateral surfaces with a basal spiculate patch on all segments. *Dorso-lateral surface:* first segment with a row of four short spines and one slender hair and a spicule situated near the outer spine; second and third with four strong hooks; fourth, fifth and sixth with a row of about five spicules. *Ventro-lateral surface:* fifth segment with a single hook; sixth and seventh with two widely spaced hooks with a basal tooth.

The *cocoon* (fig. 40, *a* & *b*) is a light brown gelatinous structure interwoven with fine threads.

Breeding places.

The larvae and pupae were found in a variety of habitats in the waters of the Victoria Nile near its source at Jinja. They were abundant on the clean smooth tops of isolated rocks situated in swiftly-flowing water in mid-stream, on the thick layer of organic matter (comprising the discarded pupal cases of many different insects) forming the surface of shelving rock in rapids, on the stalks and leaves of long filamentous grasses swirling in eddies, and on the upright stems of reeds growing at the river edge in the wash of the falls. In deep water, aerated to an extreme degree, the early stages were associated with those of *S. damnosum*, but generally in greater numbers than the latter and occurred in these places on loose rocks lying on the river bed and on the stems and blades of long pendulous grasses hanging in rapids.



33

Fig. 33.—Larva. Body scales of *S. hargreavesi* (*a*), *S. ugandae* (*b*).

The pupae are easily distinguished from those of *S. damnosum* by the presence of slender secondary filaments on the ventral surface of the respiratory organ, which are absent in the latter.

Simulium ugandae sp. n.

Female. Length 2·3 mm.; wing 2·5 mm.

Head. *Vertex, front* and *antenna* as in *hargreavesi* except that the scape and first flagellar segment of the antenna are of a lighter brown.

Thorax. Integument of *mesonotum* and *scutellum* dark brown, densely covered with closely applied deep golden scales, the latter with long marginal hairs of similar colour. *Pleura* and *halteres* as in *hargreavesi.*

Abdomen dark brown, densely covered with long golden scales; basal fringe dense, composed of moderately long yellow hairs. *Spermatheca* as in *hargreavesi.* *Terminalia* in ventral aspect as in *hargreavesi,* but when seen in lateral view (fig. 30, *c*) differs in the paraprocts and cerci; the former have a conical ventral process and the latter show no signs of a projection anteriorly. The extremely long anterior gonopophyses are a diagnostic feature.

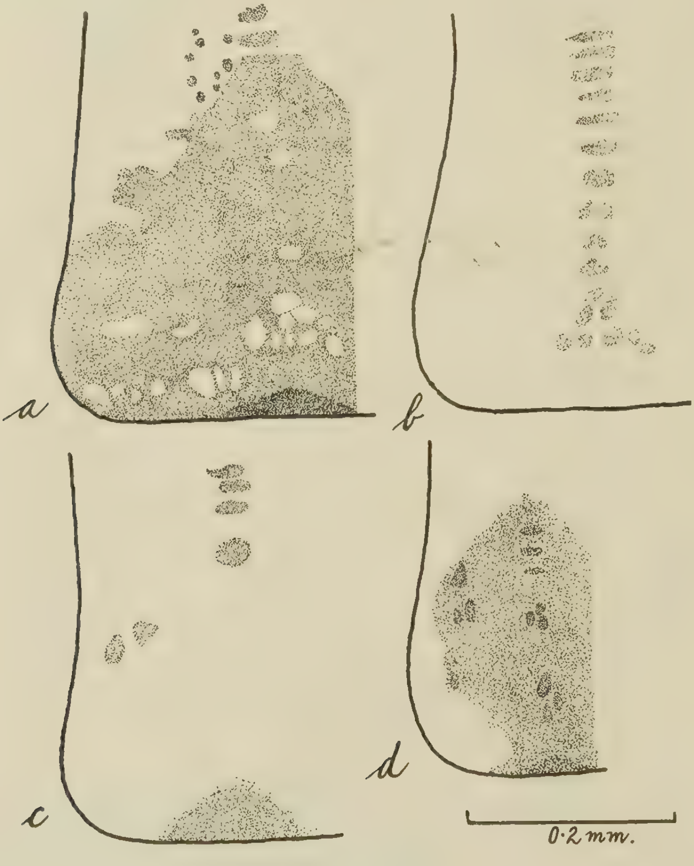


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Fig. 34.—Larva. Part of front; *S. ugandae* (*a*), *S. africanum* (*b*), *S. elgonensis* (*c*), *S. hargreavesi* (*d*).

Legs as in *hargreavesi* but darker, the basal two-thirds of the front tibiae with a conspicuous broad postero-lateral stripe.

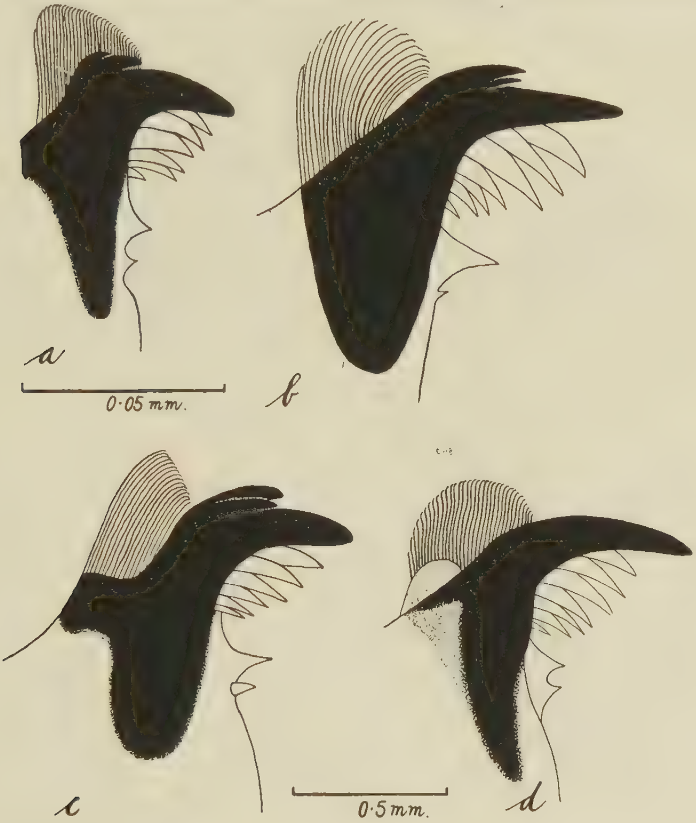
Wings as in *hargreavesi.*

Male. Length 2·4 mm.; wing 2·2 mm.

Head. *Front* and *clypeus* dark grey, the latter with long pale hairs. *Antenna* dark brown.

Thorax. Integument of mesonotum velvet-black with sparse brassy scales anteriorly, sprinkled with dark brown scales interspersed with yellow scales medially, and with dense yellowish-white scales laterally. *Scutellum* velvet-black with long deep yellow hairs. *Halteres* as in *hargreavesi.* *Pleura* slate-grey, patch absent.

Abdomen velvet-black, sparsely sprinkled with long pale hairs and with a light grey lateral patch on the fifth and sixth segments; basal fringe dense, composed of long yellow hairs. *Terminalia* as in *hargreavesi*, but with relatively longer styles bearing a conical pointed sub-apical tooth (fig. 32, *a*) and a markedly serrated distal edge to the intercoxal piece (fig. 32, *e*).



35

FIG. 35.—Larva. Mandible of *S. africanum* (*a*), *S. elgonensis* (*b*), *S. ugandae* (*c*), *S. hargreavesi* (*d*).

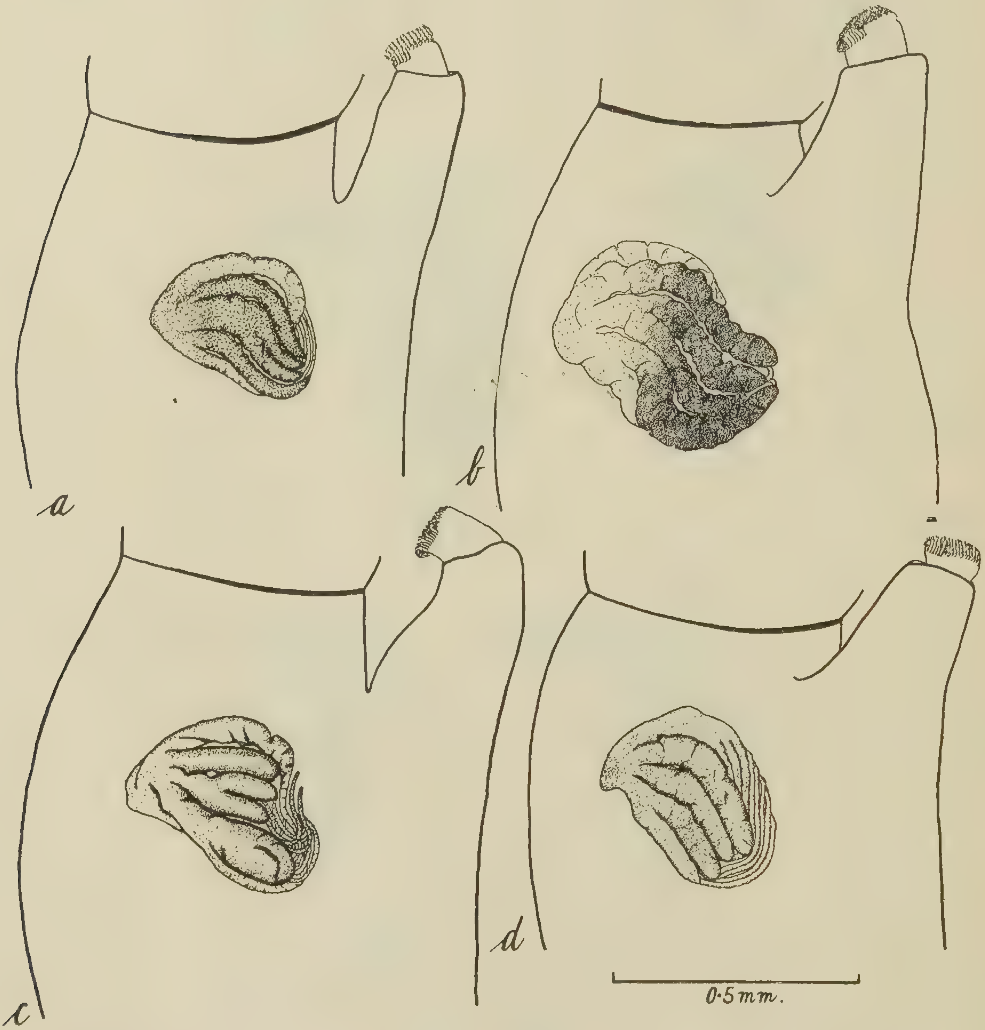
Legs dark brown. Front tibiae with the basal two-thirds pale.

Wings as in *hargreavesi.*

Holotype, ♀, Sabei, 5.v.32.
Allotype, ♂, same data.
Paratypes, 4 ♂♂, 7 ♀♀ with types.

Larva. Length of mature larva 5·7 mm. General colour dark grey, body sprinkled with narrow spines (fig. 33, *b*) chitinised in the basal half.

Head. Front with a large pigmented area as in figure 34, *a*. *Antenna, palp,* and *mentum* as in *hargreavesi*. *Mandible* (fig. 35, *c*) similar to *africanus,* but with the two small chitinised teeth situated nearer the apex of the main tooth. *Feeding-brushes* with about 52 long bristles.



36

FIG. 36.—Larva. Thoracic patch and pseudopod; *S. elgonensis* (*a*), *S. hargreavesi* (*b*), *S. africanum* (*c*), *S. ugandae* (*d*).

Thorax. Thoracic patch as in figure 36, *d*. *Pseudopod* similar to *hargreavesi.*

Abdomen. Anal gills retracted and not visible in the few specimens obtained. *Anal armature* as in *hargreavesi*. *Anal sucker* with about 180 rows each containing 50–55 hooks.

Pupa. Head and *thorax* as in *hargreavesi. Respiratory organ* (fig. 39, *b*). The respiratory filaments differ from those of the other three species dealt with in this paper by the median lobe being simple. In structure the outer wall is similar to *hargreavesi,* but is not so strongly chitinised. From the main lobes the secondary filaments arise as follows: four near the base from a single stem and four more (two on each side one above the other) in the anterior half of the median lobe; two on each of the outer lobes near the distal end and in the case of that proximal to the median lobe supplemented by an additional pair at the base. The two basal appendages differ, one consists of a narrow tube, which is conical at the tip and void of secondary filaments, and the other a lateral arm terminating in two long filaments and giving rise to another pair in the antero-median area. On account of their length, the secondary filaments when in their natural position are more conspicuous in this species than in any of the others.

Abdomen as in *hargreavesi.*

The *cocoon* (fig. 41, *b*) is of similar texture to *hargreavesi* and appears as a shield when fixed to the surface of a stone.

Breeding places.

The larvae and pupae were found in heavy shade in the waters of the River Abutakwe at 6,000 ft. near Sabei on the slopes of Mount Elgon, attached to loose stones, both clean and dirty, lying on the river bed below small cascades, and on leaves and stalks of *Polygonum* dangling in the water.

Simulium elgonensis sp. n.

Female. Length 2 mm.; wing 2·2 mm.

Head. Vertex, front and *clypeus* light grey with silver scales, the latter with long marginal hairs. *Antenna* dark brown with ash-grey pubescence except the scape, first flagellar segment and base of the second, which are ochraceous.

Thorax. Integument of *mesonotum* grey-brown with golden scales (sparse in the median area) and with three indistinct stripes which, however, are clearly seen in certain lights; the median stripe is short and the long lateral stripes lie obliquely wider apart at the base and reach almost from the anterior to the posterior border. *Scutellum* with golden scales and long golden hairs on the posterior margin. *Pleura* without patch. *Halteres* pale yellow.

Abdomen densely covered with golden scales; basal fringe with short pale hairs. *Terminalia* as in *hargreavesi* in ventral aspect, but in lateral view (fig. 30, *d*) showing small differences in the ventral process of the paraprocts and in the circus which is relatively small and rounded anteriorly.

Legs dark brown. Coxae, trochanters, femora and tibiae of mid and hind legs sprinkled with yellow scales. Front legs: tibiae with a silver postero-lateral stripe basally, tarsi slightly flattened. Hind legs with first tarsal segment broadly pale, yellow basally; calcipala, pedisulcus and claws as in *hargreavesi.*

Wings as in *hargreavesi* except that there are a few setae on the base of the subcosta.

Male. Length 2 mm.; wing 2·1 mm.

Head. Front and *clypeus* light grey with long pale hairs. *Antenna* dark brown with ash-grey pubescence.

Thorax. Integument of mesonotum velvet-black, with brassy scales disposed thickly laterally and posteriorly. *Scutellum* with brassy scales and long posterior brassy hairs. *Pleura* as in female. *Halteres* deep yellow.

Abdomen velvet-black, sparsely covered with short pale hairs; basal fringe with long yellow hairs; fifth, sixth and seventh segments with a broad grey lateral patch (narrow on the latter segment). *Terminalia* similar to *hargreavesi*, but with the trough at the apex of the intercoxal piece much less pronounced (fig. 32, *h*) and with a small sub-apical tooth (fig. 32, *c*) which is symmetrically rounded at the tip.

Legs brown. Front legs: femora with silver scales and tibiae with the basal two-thirds bearing silver scales outwardly.

Wings as in female.

Holotype, ♀, River Kaptokoi, 5,000 ft.
Allotype, ♂, same data.
Paratypes, 3 ♂♂, 4 ♀♀ with types.

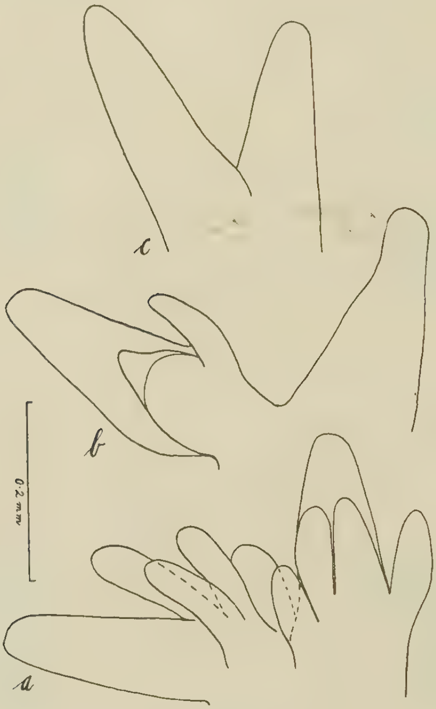


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Fig. 37.—Larva. Anal gills; median lobe right, lateral lobe left: *S. hargreavesi* (*a*), *S. elgonensis* (*b*), *S. africanum* (*c*).

Larva. Length of mature larva 5·2 mm. General colour black, body without scales or spines.

Head. Front (fig. 34, *c*) with a basal semi-circular pigmented area, four median spots situated well forward and two more near the margin and between the basal patch and median spots. *Antenna, palp* and *mentum* as in *hargreavesi*. *Mandible* (fig. 35, *b*) with a main straight-pointed tooth surmounted by two small teeth all of which are strongly chitinised, and seven lightly chitinised teeth protruding from its concave surface, the anterior three considerably larger than the rest. *Feeding-brushes* with about 60 long bristles.

Thorax. Thoracic patch as in figure 36, *a*. *Pseudopod* narrow and cylindrical, of almost the same width apically as basally.

Abdomen. Anal gills (fig. 37, *b*) trilobed, with a simple median lobe, lateral lobes with a main and two small secondary processes, one of which is narrow and cylindrical and the other triangular in shape. *Anal armature* as in *hargreavesi*. *Anal sucker* with about 150 rows each containing 40–45 hooks.

Pupa. *Head* and *thorax* as in *hargreavesi*. *Respiratory organ* (fig. 39, *a*). As in the case of the other species of this group, excepting *ugandae*, the median lobe is bifid. The three main lobes, which are heavily chitinised and rather pointed distally, have an outer wall with pigmented nodules (fig. 40, *c*), thus differentiating this species from the others dealt with in this paper. The secondary filaments, 16 in all, are disposed as follows: a pair at the base of the median lobe and of the outer lobe proximal to it, and eight arranged singly, two on each arm of the median lobe and one on each of the outer lobes, one above the other. The caudal appendages bear one and three separate filaments respectively.

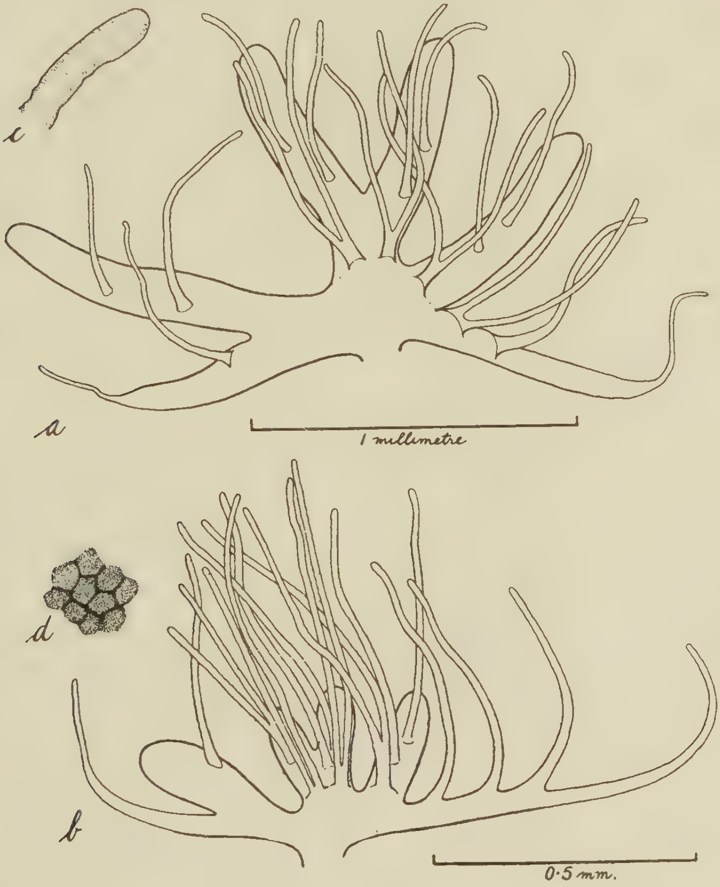

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Fig. 38.—Pupa. Respiratory organ, ventral view; *S. hargreavesi* (*a*), *S. africanum* (*b*), distal end of secondary filament enlarged (*c*), part of lobe of *S. africanum* enlarged to show reticulated structure (*d*).

Abdomen as in *hargreavesi* except for the absence of the slender hair on the first dorsal segment.

Cocoon as in *ugandae* (fig. 41, *b*).

Breeding places.

The early stages of *S. elgonensis* and *S. africanum* were found on the slopes of Mount Elgon in the River Sipi at 7,000 ft., the River Kaptokoi near Sabei at 6,000 ft. and the River Sasa at 9,500 ft. In the first named river they were found attached to the leaves and stalks of an Umbellifer and to fine tree roots swaying in the swiftly-flowing water, about three inches deep, above a precipitous waterfall, in association with *S. dentulosum* and *S. masabae*; in the latter rivers they were found in the shaded parts on leaves and stalks of *Polygonum* hanging in small rapids and on loose alga-covered stones in the turbulent waters below.

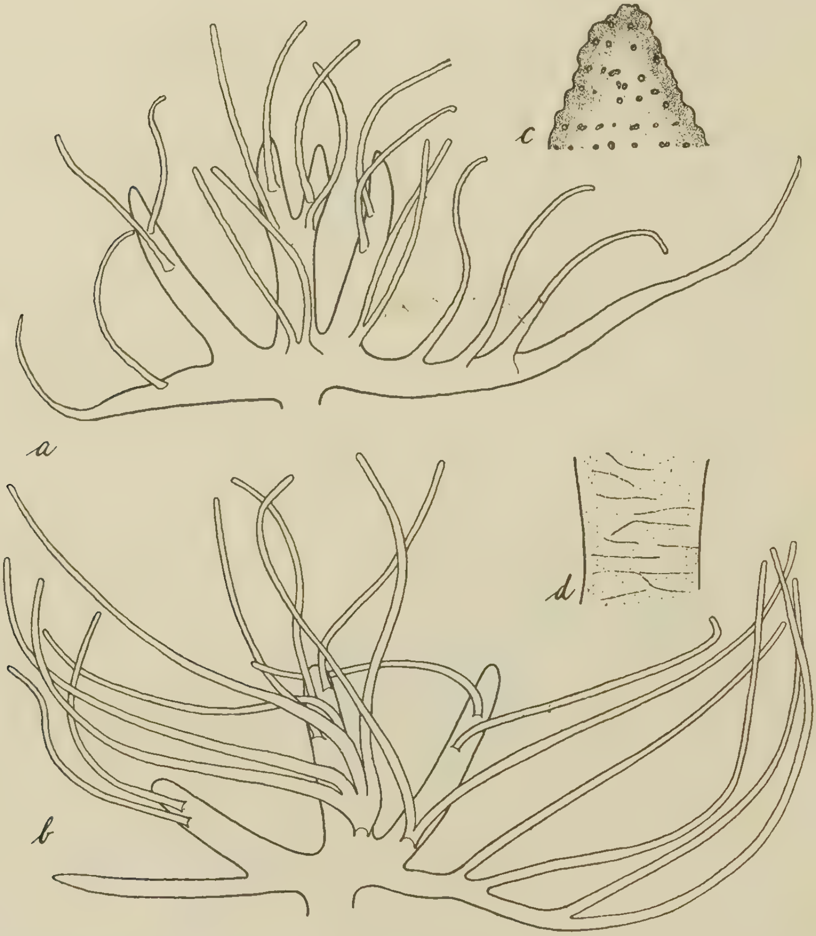

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Fig. 39.—Pupa. Respiratory organ, ventral view: *S. elgonensis* (*a*), *S. ugandae* (*b*), distal end of lobe of *elgonensis* enlarged (*c*), median area of lobe of *S. ugandae* enlarged to show the fine striated appearance which is only seen by careful focussing (*d*).

Simulium africanum sp. n.

Female. A dark species.

Length 2·3 mm.; wing 2·9 mm.

Head. Vertex, front and *clypeus* dark grey, sparsely sprinkled with dark hairs. *Antenna* entirely black with fine ash-grey pubescence.

Thorax. Integument of mesonotum dull black, thinly covered with closely applied brassy scales (except laterally where they are dense), interspersed with black scales. *Halteres* pale yellow. *Pleura* without patch.

Abdomen dull black, with scattered dark scales on the dorsal surface and dense golden scales laterally; basal fringe sparse, of short yellow hairs. *Spermatheca* as in *hargreavesi. Terminalia* as in *hargreavesi* in ventral aspect, but when examined in lateral view show a conical forwardly-projecting process of the paraprocts (fig. 30, *b*).

Legs dark brown with brassy scales except the tarsal segments and basal two-thirds of the fore tibiae which bear silver scales; front tarsi slightly flattened; first hind tarsa segment with a broad yellow basal band; calcipala, pedisulcus, and claws as in *hargreavesi*.

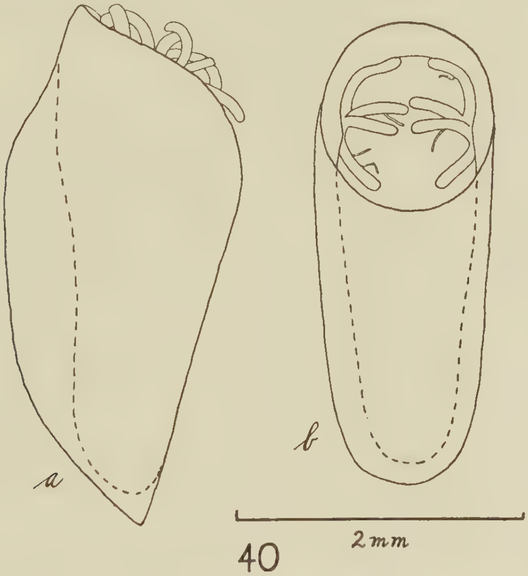

Fig. 40.—Cocoon. *S. hargreavesi*, showing natural position of pupa and respiratory organ; lateral view (*a*), ventral view (*b*).

Wings conspicuously darker than those of the other species dealt with here, apparently due to larger and denser microtrichia. Disposition of hairs as in *hargreavesi*, except that the subcosta has setae along its whole length apart from a short space at the apex.

Male. Length 2·3 mm.; wing 2·7 mm.

Head. Front, clypeus and *antenna* as in female.

Thorax. Integument of mesonotum velvet-black, thinly covered with dark brown scales medially and dense yellow scales laterally and posteriorly. *Scutellum* black with long dark hairs. *Halteres* brown with lighter tips. *Pleura* without patch.

Abdomen velvet-black, sparsely sprinkled with long dark brown hairs; basal fringe dense of long brown hairs. *Terminalia* as in *hargreavesi*, but differing slightly in that the distal edge of the intercoxal piece (fig. 32, *g*) is only slightly concave, and in the shape of the sub-apical tooth of the style (fig. 32, *b*).

Legs dark brown; front tibiae with a broad median postero-lateral stripe which is convex anteriorly; mid and hind tibiae with basal yellow scales.

Wings as in *hargreavesi*, but with a basal cell.

Holotype, ♀, Sipi, 7,000 ft.
Allotype, ♂, same data.
Paratypes, 14 ♂♂, 22 ♀♀ with types.

Larva. Length of mature larva 6·2 mm. General colour black, body without scales or spines.

Head. Front (fig. 34, *b*) with a median row of about twenty pigmented spots. *Antenna*, *palp* and *mentum* as in *hargreavesi*. *Mandible* (fig. 35, *a*) with a strong main tooth, surmounted by two small teeth all of which are heavily chitinised and with six smaller teeth protruding from its concave surface, the basal tooth considerably smaller than the rest. *Feeding-brushes* with about 55 long bristles.

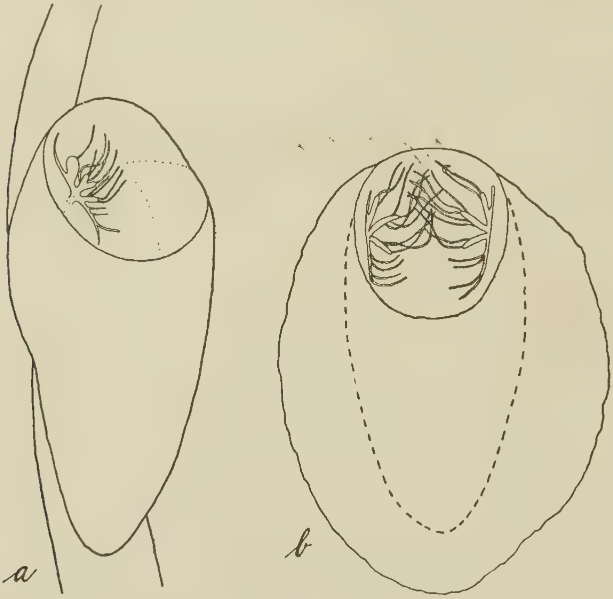

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Fig. 41.—Cocoon showing natural position of pupa and respiratory organ: *S. africanum* in ventro-lateral aspect (*a*), *S. ugandae* in ventral aspect (*b*).

Thorax. Thoracic patch as in figure 36, *c*. *Pseudopod* broad and reaching little above the head suture.

Abdomen. Anal gills (fig. 37, *c*) trilobed with simple lobes, the lateral larger than the median. *Anal armature* as in *hargreavesi*. *Anal sucker* with about 180 rows each containing 45–50 hooks.

Pupa. Head and *thorax* as in *hargreavesi*. Respiratory organ (fig. 38, *b*). The respiratory filaments of this species are characterised by short, stout, main lobes, which under high magnification are seen to have an outer wall of a finely reticulated structure (fig. 38, *d*). They are rounded anteriorly and bear relatively long secondary filaments of similar number and arrangement to those of *hargreavesi*, except that the outer larger lobe, which is bulbous, carries a single filament in the median antero-lateral area. One caudal appendage is void of secondary filaments, while the other bears three at equal intervals.

Abdomen as in *hargreavesi,* but without the single hook on the ventral surface of the fifth segment.

The *cocoon* is a dark brown gelatinous cone-shaped structure and is depicted in figure 41, *a* attached to the thin root of a tree.

Breeding places.

These have already been described under the previous species.

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A STUDY OF THE GENUS *ACTINOPTERA* ROND. (DIPTERA, TRYPETIDAE), IN THE ETHIOPIAN REGION

By H. K. Munro, B.Sc.

[Read 6th December, 1933.]

Actinoptera Rond.

Rondani, 1871, Bull. Soc. ent. Ital., **3** : 162.
Hendel *in Lindner*, 1927, Fliegen Paläarkt. Reg., **49**, Trypetidae : 161.
Shiraki, 1933, Mem. Fac. Sci. Taihoku Univ., **8**, (Ent. 2) : 446.
Syns. *Urellia* Lw., pp. *Trypanea sensu* Bezzi, pp.

When in 1924 Bezzi * published his summary of the Ethiopian Trypetidae, he does not appear to have published anything on the division into smaller groups of the species he included in the genus *Trypanea*. In his tables (*loc. cit.*, p. 140) one small and two larger sections are, however, indicated. The species of the two latter, those with normal stigma and two or four scutellar bristles would be included in *Trypanea* and *Acanthiophilus* according to Hendel's later work (Hendel, *loc. cit.*, pp. 197 and 202). In the small group are those species with a very short stigma : of these one, *Trypanea rivularis* Bez., is excluded on account of the elongate proboscis and the two superior orbital bristles. The other species, *kovácsi* Bez., *peregrina* Adams, *mundella* Bez., *brachystigma* Bez., *hemimelaena* Bez., and *rosetta*, a new species described here, should be placed in *Actinoptera* for reasons to be discussed. I have seen specimens of all except *brachystigma* and *hemimelaena* of which only the types in the British Museum are known. I thank Miss Daphne Aubertin for the information that there is only one superior orbital bristle in each. With few exceptions noted all the material recorded in this paper was collected or reared by the author.

That Bezzi was aware of the relationship of the species he knew to those of the palaearctic region, such as *Actinoptera discoidea* Fall., is evident from his remarks in his description of *Trypanea urophora* (a synonym of *peregrina* Adams). However, he did not separate the species from *Trypanea*, and as there is no reference in any of the descriptions to the single superior orbital bristle, other workers could not, in the absence of specimens, definitely connect the African species with the short stigma with the genus *Actinoptera*. The short stigma in itself would not have been sufficient as is the case in the species *Trypanea rivularis*.

The limits of the genus *Actinoptera* accepted here are those given by Hendel (*loc. cit.*) and it is not proposed to discuss its general relationships. Suffice it to say that on the whole the species appear to be more closely allied to those placed in *Trypanea* : I have one specimen of *Actinoptera peregrina* that has two superior orbital bristles on the one side. The chief characters of the genus are : the relatively broad frons, the single superior orbital bristle, short proboscis, short stigma, outwardly diverging third and fourth veins and the *Trypanea*-like wing-pattern.

Among the African species three groups may be noted : (1) *hemimelaena* and *brachystigma*, larger species with a more extensive, strongly marked wing-pattern; (2) *peregrina*, *mundella* and *kovácsi*; and (3) *rosetta*. The last two groups differ noticeably from the palaearctic species in the reduction of the wing-pattern.

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* Bezzi, 1924, Bull. Ent. Res., **15** : 73–155.

A. discoidea is included for comparison and the species may be distinguished as follows :—

1 (6). Wing-pattern more extensive, covering outer three-fifths of wing approximately and including outer ends of discal and third posterior cells . . . . 2.
2 (5). Wing-pattern with marginal and discal hyaline spots smaller, thus the black more extensive and the rays less pronounced: two small hyaline spots at outer end of discal cell and bar from stigma to upper cross-vein apparently not so pronounced . . . . 3.
3 (4). A yellowish patch on upper cross-vein . . . . . . *brachystigma* Bez.
4 (3). No such yellow patch . . . . *hemimelaena* Bez.
5 (2). Wing-pattern with marginal and discal spots larger, thus black reduced and rays well defined; bar from stigma to upper cross-vein more pronounced . . . . Palaearctic species.
(*a*) A single large hyaline spot at end of discal cell . *discoidea* Fall.
6 (1). Pattern restricted to outer third of wing*; bar from stigma to upper cross-vein absent or faint, thus large basal spot in first posterior cell and outer spot in discal cell incomplete or only faintly defined on inner side . . . . 7.
7(12). Pattern well defined and regular, apical fork complete and strong: base of ovipositor one-third to half total length,† and more attenuate apically . . . . 8.
8 (9). Femora black; outer end of discal cell with two faintly indicated hyaline spots; ovipositor one-third total length . . . *kovácsi* Bez.
9 (8). Femora yellow, or only hind pair somewhat darkened; outer end of discal cell with single large faintly indicated hyaline spot if any . 10.
10(11). Larger species. Bar from stigma to upper cross-vein usually complete but faint; the two hyaline spots at outer end of first posterior cell before the apical fork usually complete, and as the hyaline indentations in the second posterior cell also tend to become divided crosswise, the pattern generally has a more reticulate appearance: base of ovipositor half total length. . . . . *peregrina* Adams.
11(10). Smaller species. Bar from stigma to upper cross-vein usually absent; spots before apical fork usually fused with those above and below,

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* This statement must be taken to apply to the fully developed pattern, that is, where the wing-membrane is blackened or at least strongly infuscated and the microtrichiae black. Under higher magnification (in *peregrina*, for instance) a pattern can often be discovered on the basal half of the wing, but there it is formed by blackish microtrichiae, the membrane being colourless or only slightly infuscated in places. Under moderate magnification in a direct comparison between specimens of *peregrina* and *discoidea* the difference in the intensity of the pattern on the basal half is generally quite noticeable.

† In referring to the total length in TRYPETIDAE, authors have used the term " length of body." This is incorrect and it becomes more confusing when the same authors use the word " body " for the abdomen or thorax or both together. Smith's *Glossary of Entomology* states :—" Body : the trunk : usually applied to the thorax only, rarely to the abdomen alone; sometimes to the thorax and abdomen combined." In any case the head is always excluded, hence it seems that the word body is one that could well be discarded in insect terminology. For the length of the whole insect I propose to use " total length " or simply " length " if there is nothing in the immediate context to cause confusion. I take the measurement from the anterior edge of the head (excluding the antennae) to the end of the abdomen, measuring the parts more or less separately if necessary where the insect is bent as is often the case : in the female only the base of the ovipositor is included, not the fully extended organ.

and indentations in second posterior cell not so often divided, hence pattern less reticulate in appearance; base of ovipositor one-third total length . . . . *mundella* Bez.

12 (7). Wing-pattern much reduced, rather irregular and disconnected; apical fork separate from rest of pattern as a rule; base of ovipositor less than one-third total length and less attenuate apically . *rosetta* sp. n.

In the foregoing tables an attempt is made to separate the species on characters that can be examined without dissection of the specimens. The use of the wing-pattern with few other characters to supplement it is rather weak, but may be employed with more certainty when the limits of its variation in a species can be gauged from a series of specimens. In the present case it is particularly weak in the separation of the European *discoidea* and the South African *peregrina*, because several specimens of the latter have the basal portion of the pattern so much darkened that, in the absence of locality data, one would have little hesitation in regarding the specimens as of possible European origin. Without dissection I have not been able to detect any other more reliable characters to separate the species.

In view of the success attending the use of the genitalia especially in the Lepidoptera, it might be anticipated that the study of these structures in the TRYPETIDAE would afford characters of use in separating closely allied species as well as indicating relationships in general. Apart from the lack of sufficient material for the purpose, it does not seem opportune to begin such a study on so small a group : first, very little comparative work on the Diptera in general has yet been done, and then more general work on the TRYPETIDAE in particular is required.

I have, however, made a few tentative experiments in their study. In the TRYPETIDAE the genitalia are mainly represented by the ninth segment of the abdomen. This is a somewhat capsular structure and, as it is the most conspicuous portion visible, it seems to be what authors term the "genitalia." In the species discussed here it seems to show some variation in shape, but the differences are such as could only be fully appreciated after more careful and extensive study. It was noted in the preparations made that the sternites, particularly the fifth, showed certain variations in shape, and this will be discussed further under the species concerned.

Actinoptera hemimelaena (Bez.).

Bezzi, 1920, Bull. Ent. Res., 10 : 264, pl. xviii, fig. 9.

This species was described on a male from Aburi, Gold Coast, in the British Museum and has not since been recorded. Bezzi compares it with *guimari* Beck., a species placed by Hendel in *Urelliosoma*, and which has moreover two superior orbital bristles.

Total and wing-lengths 3·2 mm.

Actinoptera brachystigma (Bez.).

Bezzi, 1924, Bull. Ent. Res., 15 : 143 (*Trypanea*).

A larger species (total and wing-lengths 4·0–4·5 mm.) described on a pair from Cholo, Nyasaland, in the British Museum, and not since recorded. It seems to be closely allied with and very similar to the preceding species.

Actinoptera kovácsi (Bez.).

Bezzi, 1924, Bull. Ent. Res., **15** : 140, 143 (*Trypanea*).

A complete description of this species was not published by Bezzi. I am indebted to Dr. Z. Szilady of the Hungarian National Museum for sending me the types (a male and a female) for study. It may be considered a distinct species on account of the black femora (not in itself a sufficiently strong character), the two faint hyaline spots at the outer end of the discal cell, and the base of the ovipositor which is about one-third the total length and thus shorter than in *discoidea* and its allies, and finally the peculiar shape of the third antennal joint which is short and widened outwardly in side view.

The length of the male is 2·2 mm., of the female 2·4 mm.

Actinoptera discoidea (Fall.).

Fallén, 1814, Vetensk. Akad. Handl., **1814** : 171.
Hendel in Lindner, 1927, Fliegen Paläarkt. Reg., **49**, Trypetidae, p. 162, fig. 65, Pl. 11, F. 4.
Syns. (*teste* Hendel) *aestiva* Meig., 1826; *gnaphalii* Lw., 1844; *aestiva* Rond., 1871.

This palaearctic species has been included for comparison as *peregrina* is so very like it. In his tables Hendel (*loc. cit.*) states that the section of the costa between the ends of the first and second veins is as long or a little longer than that between the second and third veins.* It does not, however, seem of much use as a basis for separating species. This point is referred to again under the following species.

In the wing of *discoidea* the bar from the stigma, across the upper cross-vein and discal cell is always complete and well marked; thus the large hyaline spot at the outer end of the discal cell and that at the inner end of the first posterior cell are complete. There is also as a rule a complete hyaline spot at the outer end of the third posterior cell and occasionally a fainter indication of a hyaline spot in the discal cell before the upper cross-vein.

The shape of the fifth sternite of the male is shown in fig. 1 a.

Actinoptera peregrina (Adams).

Urellia peregrina Adams, 1905, Kansas Univ. Sci. Bull., **3** : 170—types in Kansas University. Bezzi, 1908, Bull. Soc. ent. Ital., **39** : 142—in list.
Trypanea peregrina Adams. Bezzi, 1918, Bull. Ent. Res., **9** : 44; 1920, **10** : 264; 1924, **15** : 143; 1924, Ann. S. Afr. Mus., **19** : 562, pl. xv, fig. 117. Munro, 1926, Union S. Afr., Dept. Agr., Ent. Mem. **5** : 33; 1929, Ann. S. Afr. Mus., **29** : 31.
Trypanea urophora Bezzi, 1918, Bull. Ent. Res., **9** : 44—types in British Museum.

After careful consideration I must conclude that the specimens from Southern Africa are a form of the species represented by *discoidea* in Europe. The name *peregrina* is retained as a species for the present, but it may be regarded as a variety of *discoidea*. At the same time this does not seem to express the position fully: both may be divergent forms of one species and not necessarily the one derived from the other.

The use of the wing-pattern is not very satisfactory, although in South

---

* Hendel's actual words are "Kostalabschnitt zwischen r_{2-3} und r_{4-5} so lang oder wenig länger als der folgende." Surely he means "zwischen r_1 und r_{2-3}?" as in the first portion of the couplet, otherwise the statement seems meaningless. I have taken the amended rendering.

African specimens the pattern on the basal half of the wing is as a rule paler and much less developed. The comparative lengths of the sections of the costa between the ends of the first and second and the second and third veins are not very reliable. In seven specimens of *discoidea* (for which I thank Dr. Walther Horn of the Deutsches Entomologisches Institut) the outer length varied from 73 per cent. to 92 per cent. of the inner, and in eighteen specimens of *peregrina* from 55 per cent. to 77 per cent.

While it is not proposed to discuss the genitalia in detail here, it may be noted that in a few preparations made little difference was apparent in the male genitalia, particularly in the shape of the capsular portion (ninth segment) and the associated claspers. In the preparations, however, there were noted what seemed to be fairly constant differences in the shape of the fifth sternite. In both *discoidea* (fig. 1 a) and *peregrina* (fig. 1 b) it is strongly bifurcate posteriorly, so much so as to appear **Y**-shaped. In South African specimens the posterior emargination is deeper and the arms about one-third longer than the anterior portion, while in the European specimens it is shallower and the arms shorter, only about as long as the anterior portion. It may be noted in passing that the fifth sternite is somewhat asymmetrical, probably in relation to the torsion of the genital segments. A similar difference in the female (the sixth sternite in this case) was not observed and the base of the ovipositor (seventh segment) in each appears identical and about half the total length.

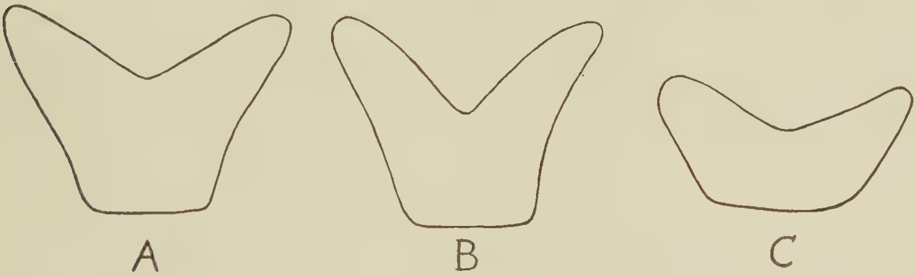

FIG. 1.—Fifth sternites of males of a, *Actinoptera discoidea* Fall.; b, *A. peregrina* Adams; c, *A. mundella* Bez.

The two species are of the same size: males 2·6 mm., females 3·5 mm. in length.

I have the following material:—

A male and a female cotype kindly sent to me by Professor H. B. Hungerford of Kansas University. These are labelled "Salisbury, S. Africa, *F. L. Snow*, Oct. 1900, 5050 ft. in swamp." Cotype. *Urellia peregrina* Adams. There is a pair in the collection of the South African Museum with similar collector's labels but no name label. Five specimens, Prospect, Cape, October and November 1922; one, East London, 29.iv.25; four, Pretoria, June–July 1925 from puparia in flowers of *Helichrysum setosum*; one, Pretoria, 21.ii.31; five, Port Shepstone, May 1926, puparia in flowers of *Helichrysum fulgidum*; eight, Barberton, August 1931, puparia in flowers of *Helichrysum* sp.; one, Scottburgh, Natal, June 1931, *G. C. Haines*, puparium in flower of *Helichrysum foetidum*; nine, Lourenço Marques, September 1928, puparia in flowers of *Helichrysum setosum.*

Actinoptera mundella (Bez.).

Trypanea mundella Bezzi, 1924, Ann. S. Afr. Mus., **19** : 562, pl. xv, fig. 118; 1924, Bull. Ent. Res., **15** : 143.

This species was very shortly characterised by Bezzi as a variety of *peregrina*, but it can be sufficiently well differentiated to be regarded as a distinct species, smaller than the other two (i.e. *discoidea* and *peregrina*). The length of the male is 2·2 mm., of the female, 2·6 mm.

The pattern on the basal half of the wing is consistently less developed, the bar from the stigma to the upper cross-vein and across the discal cell is never complete, at most being represented by faint spots in the marginal and discal cells, and perhaps more often the upper cross-vein is a little infuscated on either side. The relative lengths of the costa between the first and second veins and the following section are much the same as in *peregrina* but rather less on the average.

The capsular portion of the male genitalia seems rather more thickset and the fifth sternite (fig. 1 c) is not so strongly Y-shaped. The base of the ovipositor is only one-third the total length.

I have the following material :—

Types, male and female, Pretoria, 1.i.23 and 5.i.23; paratypes, a male, Pretoria, 1.i.23 and three males, Prospect, Cape, 24.x.22. Other specimens: two, Pretoria, 12.iii.26 and 14.ii.32; two, Prospect, 18.xi.22 and one, 17.iii.24; one, Elliott, Cape, 11.v.24; one, Stellenbosch, Cape, 10.v.28; ten from the Cape Peninsula (Fish Hoek, Muizenburg and Clovelly), October and November 1931.

Actinoptera rosetta sp. n.

A small gall-forming species that may be distinguished from the others by the characters given in the tables.

♂♀. Length: male, 1·9 mm. (varying from 1·5 to 2·0 mm.), female, 2·2 mm. (2·0 to 2·3 mm.). The wing is as long as the total length in both sexes. *Head* whitish-yellow, as long as high and one and a half times as wide; *occiput* flat, black, narrowly yellowish on margins, bristles whitish, thickened; *frons* about as long as wide at vertex and a quarter narrower at antennae, at vertex three times as wide as an eye, flat, bare, yellow, orbits whitish with some pale pubescence, ocellar dot brown, ocellar bristles strong, one upper and two lower orbitals; *lunule* yellow, short and wide; *antennae* yellow, nearly as long as face, third joint broadly rounded; arista brownish, minutely pubescent; *face* flat, pale whitish-yellow; epistome rather prominent, cheeks narrow, one-third width of, and genae as wide as third antennal joint; palpi yellow; proboscis yellow, short, labellae moderately long. *Thorax* normal, black with blackish blue-grey dust and sparse, rather coarse white pubescence; bristles pale brownish, pteropleural and sternopleural whitish; dorso-centrals just behind suture; a pair of basal scutellars. *Legs* and halteres yellow. *Wing* rather narrow; a single costal bristle; stigma short; ends of third and fourth veins diverging somewhat; upper cross-vein a little shorter than its distance from lower (rather shorter in female than in male); hyaline, with much reduced, disconnected and rather irregular pattern on apical half; outer end of stigma darkened and bar to upper cross-vein faint to moderate, but usually only a spot in marginal cell, upper cross-vein darkened or also slightly infuscated on either side and a faint mark across discal cell to fifth vein; two narrow, often very irregular rays across second posterior cell and one along lower cross-vein; apical fork complete, but represented by a curved band separated from the rest of the pattern (occasionally connected by a narrow streak along middle of first posterior cell) widened on wing-margin and enclosing a large hyaline spot that fills the end of the first posterior cell; the central black area is more usually broken up by two to five small hyaline spots, rarely not so. *Abdomen* blackish with slight dust and sparse white pubescence; in male hind margins of second, third and fourth segments may be very narrowly yellowish, barely so in female. Genitalia (capsule) black; base of ovipositor shining black, with slight black pubescence, short, rather stout-conical, a quarter to rather less than one-third total length.

Type male, 16.xii.31, type female, 6.iii.32; paratypes, three males and one female, 5.xii.31; five males and four females, 16.xii.31; one male and one female, December 1931, collected and reared at Pretoria (Kilnerton) and four males and two females, collected at Lourenço Marques, 18.i.19.

The small shining black puparia were found in rather inconspicuous rosette galls at the ends of twigs of *Helichrysum krausii* at Pretoria.

THE MALE AND THE FEMALE GENITALIA AND THE BIOLOGY OF *EUCHALCIDIA CARYOBORI* HANNA (HYMENOPTERA, CHALCIDINAE)

By A. D. Hanna, B.Sc., A.R.C.S., Ph.D.

[Read April 4th, 1934.]

With Thirty-eight Text-figures.

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Introduction.

In October 1931 Mr. C. Potter and Mr. A. Smith of the Department of Entomology, Imperial College of Science and Technology, obtained samples of senna (*Cassia* sp.) pods from London docks which were infested by the Bruchid, *Caryoborus pallidus* Oliv. Amongst the Bruchids, I found also a Hymenopterous parasite which lays its eggs in the cocoons of the early pupa and late larval stages of the beetle. The larva, after hatching, lives externally on the host inside the cocoons. Dr. H. Scott of the British Museum and Dr. Ferrière of the Imperial Institute of Entomology were able to place this parasite in the genus *Euchalcidia*, but could not identify it specifically. They very kindly sent specimens to Dr. L. Masi, who wrote that it was not a species of *Euchalcidia* with which he is acquainted but it might be close to *E. nebulosa* Fonsc. Dr. Scott then wrote Mons. Berland of the Paris Museum, who kindly sent a male and a female of *E. nebulosa.* Fonscolombe's collection seems to be lost, and these specimens were identified by Grillant of Lyons and were found in the de Gaulle collection. The female *E. nebulosa* is definitely different from the new species. The male of *nebulosa* does not differ, but there is no evidence that it really corresponds to the female. The best course appeared to be to treat the Bruchid parasite as a new species (see Hanna, 1934) until more is known about *E. nebulosa.*

When studying the oviposition, I found that very little is known about the detailed structure of the different parts of the ovipositor and the muscles that govern the stylets and their sheath. I therefore think it desirable to give a short description of them.

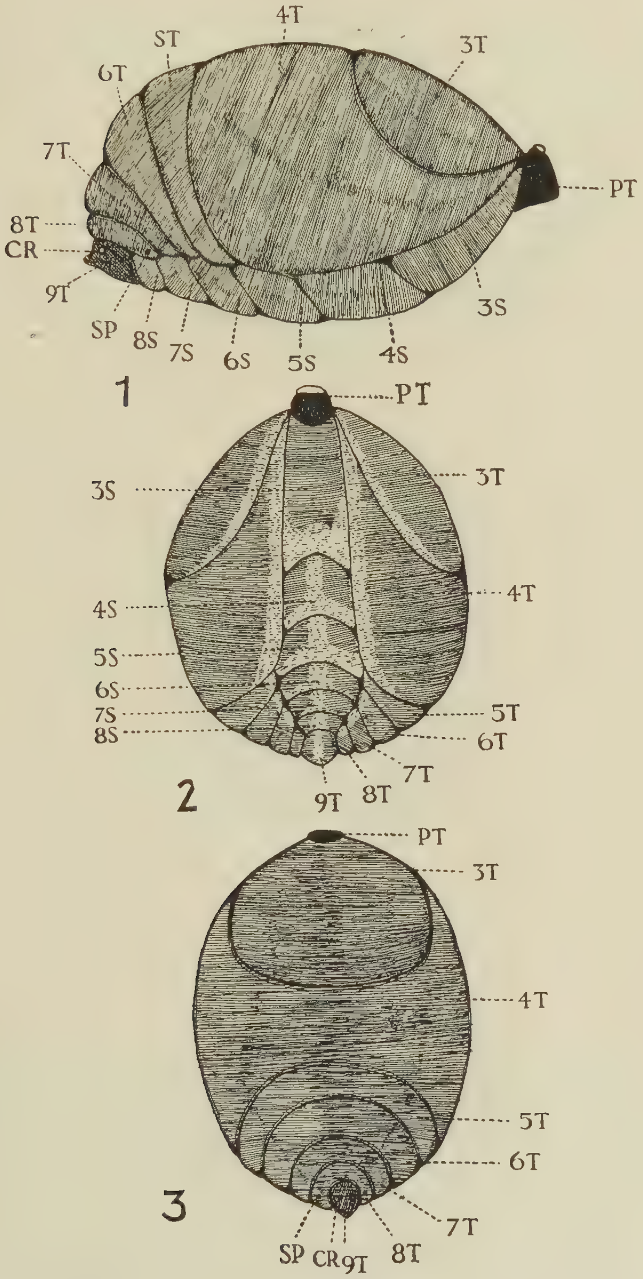
The Abdomen.

The abdomen is pear-shaped, its apex being narrower than the base which is joined to the thorax by a stalk. In the female it measures about 1·6 mm. in length and 0·1 mm. across.

(I) The *female abdomen* consists of nine segments with the tergites very dark metallic black. The tergites are well developed and extend ventrally so as to cover most of the sternites which are not so dark and form a sort of ventral keel.

The *first segment* is fused with the thorax to form the propodeum. The *second* is the petiole, which is very short and slender but heavily chitinised. When looked at laterally, it is triangular in outline, one side being ventral (fig. 16). In a front view it is V-shaped, and between its two arms there is a triangular foramen through which the viscera pass into the abdomen (fig. 16, F). On the upper inner sides of the arms there are two sclerites which proceed upwards and inwards, meeting in the median line (fig. 16, CTR) to form an attachment for the muscles which move the abdomen. The *third segment* (fig. 4, 3 T and 3 S) has a very large semicircular tergite which does not extend ventrally like the other tergites. It rests in front on the internal skeleton of the petiole. Its sternite is very long and its articulation to the petiole can be seen in fig. 16. The *fourth segment* (fig. 4, 4 T & 4 S) is by far the largest segment of the abdomen as its tergite occupies nearly one-third of its area. Its dorsal surface is not so broad as its lateral surface, which extends forwards to reach the petiole. Its sternite is rather small and has a keel. The *fifth and sixth* segments (figs. 4, 5 & 6, 5 T, 5 S, 6 T & 6 S) are subequal in size. Their tergites consist of incomplete rings with their sides produced forwards. Their sternites are similar to that of the fourth segment. The *seventh* segment (figs. 4, 5 & 6, 7 T & 7 S) is different from the preceding ones, the tergite extends only a little distance laterally. It embraces the eighth tergite posteriorly. The sternite is longer and has a little notch in the posterior median line. Its detailed structure will be dealt with when considering the female reproductive organs. The *eighth segment* is incomplete owing to the apparent absence of its sternite. The tergite is semicircular and its sides are not produced laterally as in the other tergites. On its outer surface, near its anterior angles, there are two very small spiracles (fig. 4, SP) which are the only ones on the abdomen. The *ninth tergite* is the apparent terminal tergite. It is heavily chitinised and deeply concave on the dorsal side, where it has a median longitudinal suture dividing it into two. On each side of this suture there is a circular pit (the cercus) (fig. 4, CR) which carries very long articulated hairs. The ninth tergite is keeled ventrally and extends forwards as the outer plate of the sting, which will be described later.

(II) The *male abdomen* is smaller than that of the female and can readily be distinguished by its rounded posterior end. There are ten tergites and ten


4T
ST
3T
6T
7T
PT
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9T
SP
8S
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4S
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PT
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3T
4T
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5S
6S
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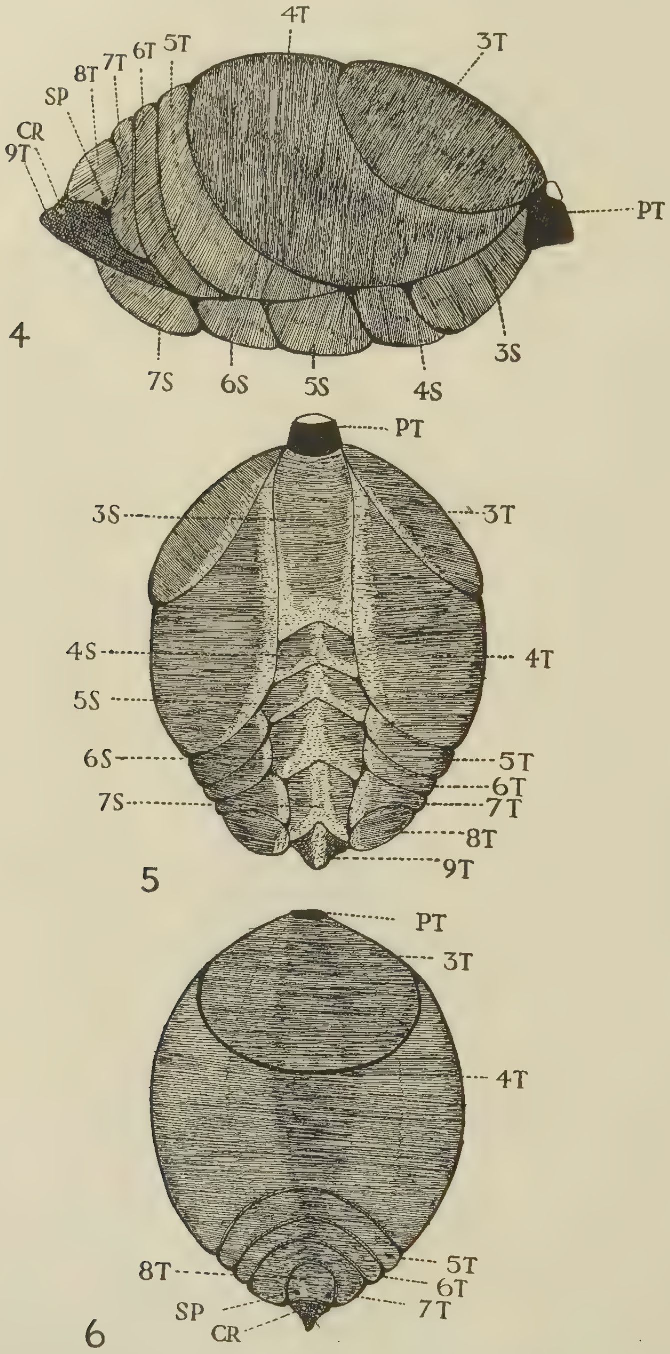
5T
6T
7T
9T
8T
2
PT
3T
4T
5T
6T
3
7T
SP
CR
9T
8T

Figs. 1–3.—(1) Lateral view of the male abdomen. cr, cercus; t, tergite; s, sternite; pt, petiole; sp, spiracle. (2) Ventral view of the same. (3) Dorsal view of the same.

sternites resembling in their shape those of the female except that the tergites of the sixth, seventh and eighth segments are broader dorsally and become narrow laterally. The seventh tergite is similar to the preceding ones and does


4T
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6

FIGS. 4–6.—(4) Lateral view of the female abdomen. (5) Ventral view of the same. (6) Dorsal view of the same. CR, cercus; T, tergum; S, sternum; SP, spiracle; PT, petiole.

not embrace the eighth tergite as in the female; there is also an eighth sternite which is apparently absent in the female. The ninth tergite and sternite are heavily chitinised. This tergite also carries the cerci (fig. 1, CR) and its tip is flattened out to form an articulated anal papilla or the tenth tergite. There is a corresponding papilla ventrally which is the tenth sternite.

The Female Armature.

The ovipositor is a highly developed organ modified for stinging. It is situated in the abdomen and occupies a large space on the ventral side a little distance behind the petiole. It does not project from the apex of the abdomen. The ovipositor consists of the following parts :—

(1) The *stylet-sheath* (fig. 8, STYS) is formed of two very long and thin chitinous rods which fuse distally to form a groove with thicker edges. At the base it bifurcates into two diverging arms, each bent upwards in a semicircle. These are also grooved to hold and guide the stylets (fig. 10). The tip of the fused sheaths has four projecting barbs diminishing gradually in size towards the tip (fig. 9). Near the base of the sheath, before it bifurcates, there is on each side a triangular heavily chitinised process (fig. 8, CS). Because of the function of this process, the name " *rotatory process* " may be suggested for it. Its structure is complex and very difficult to investigate owing to its minute size. A very powerful binocular microscope must be used as it is a thick solid process and a monocular microscope is insufficient. It is a triangular piece fused with the base of the stylet-sheath. The anterior lower part of the triangle is (figs. 13 & 15) produced forwards and then reflected upwards in a groove on the anterior upper surface to form the root of the stylet (figs. 13 & 15, RSTY). There is also a process which is the continuation of the posterior part of the triangle (fig. 15, CRL), fitting in between two chitinous arms in the stylet-sheath (fig. 15, STYS.)

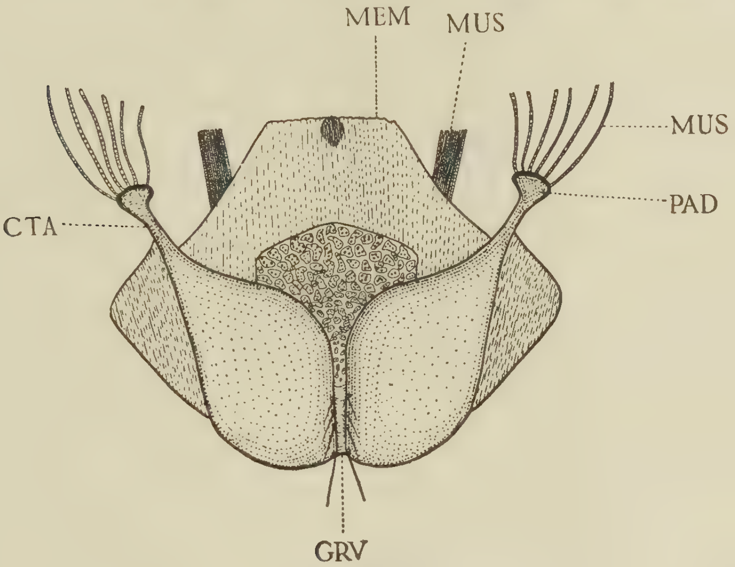
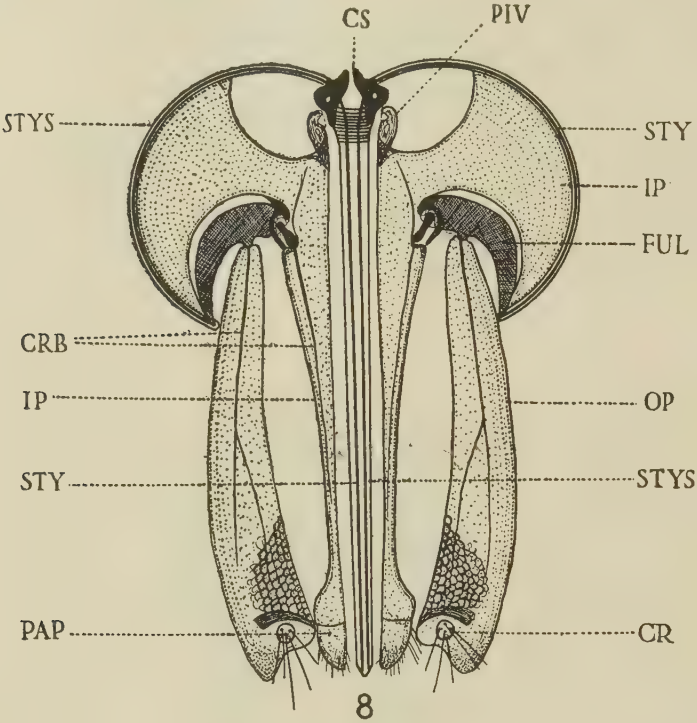


FIG. 7.—Seventh sternite of the female.
CTA, chitinous arms; GRV, groove; MUS, muscles that lower the sting down; MUS', muscles that raise the sting up; PAD, chitinous pad.

This strengthens the sheath during rotation at a moment of great tension. These structures can only be clearly seen when looked at laterally.



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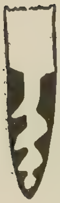

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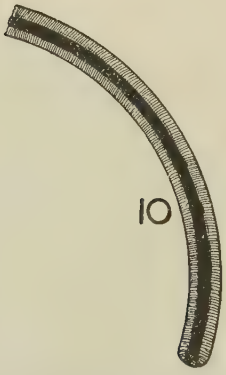

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FIGS. 8–10.—(8) The ovipositor. CRB, chitinous rib; CS, chitinous rotatory process; FUL, fulcral plate; IP, inner plate; OP, outer plate; PAP, palp; PIV, pivoting process; STY, stylet; STYS, stylet-sheath; CR, cercus. (9) Teeth at the tip of the stylet-sheath. (10) The stylet in its groove in the stylet-sheath.

At the base of the stylet-sheath, just before it bifurcates into two, there are a number of transverse chitinous ribs which help to hold the two rods of the sheath together at a point of particular tension.

The stylets are also very long and slender rods held together posteriorly by a ridge on each ventral side of the sheath, which fits into a groove on the dorsal side of the stylets, so that the three pieces together form a central canal. The stylets are pointed at their free ends and are attached to the upper tip of the fulcrum at their base (fig. 8, STY).

(2) The *inner plates* of Imms, corresponding to the oblong plates of Snodgrass, are two long chitinous lamellae on each side of the sheath expanding in a vertical plane at their posterior end, where they carry two palp-like organs (fig. 8, PAP) covered with long hairs. Anteriorly they expand dorsally in a vertical plane to form a thin chitinous plate. The outer edge is fused with the diverging arms of the stylet-sheath. The ventral anterior extremity is continuous with a triangular sclerite articulating to the centre of the rotatory process (fig. 8, PIV) and may be called the "*pivoting sclerite*." It is twisted 180° to the plane of the inner plate (fig. 14) and has a transverse groove (fig. 14, GRV) a little behind its tip where the sting is held and kept in position during stinging, relieving the muscles. A little behind this sclerite, there is a chitinous rib running posteriorly in the lamella of the inner plate for a considerable distance (fig. 8, CRB). At the base of this rib the fulcral plate articulates with the inner plate. The function of the rib is to afford attachment to the muscles which work the sting and to give a firm attachment to the fulcral plate.

(3) The *outer plates* of Imms, the quadrate of Snodgrass, are situated on the outer side of the inner plate and are heavily chitinised (fig. 8, OP). Each is articulated at its anterior end to the middle of the fulcral plate. It broadens and becomes more chitinised posteriorly where it is ornamented with punctures. Near its posterior end, it carries the circus (fig. 8, CIR) which is a depression forming a sort of a cup with a membranous bottom beset with very long hairs. Like the inner plate, on its anterior surface, it has a chitinous rib bifurcating posteriorly (fig. 8, CRB).

(4) The *fulcral plates* of Imms, triangular plates of Snodgrass, are triangular in shape (fig. 8, FUL) each with its base heavily chitinised and articulated by means of a chitinous rod to the inner plate. Its apex is thinned out and is attached to the base of the stylet.

My conclusions agree with Alder's work on the structure of the ovipositor in CYNIPIDAE, Kraepelin's on the ovipositor of the Hymenoptera, and Imms on that of a Chalcidoid.

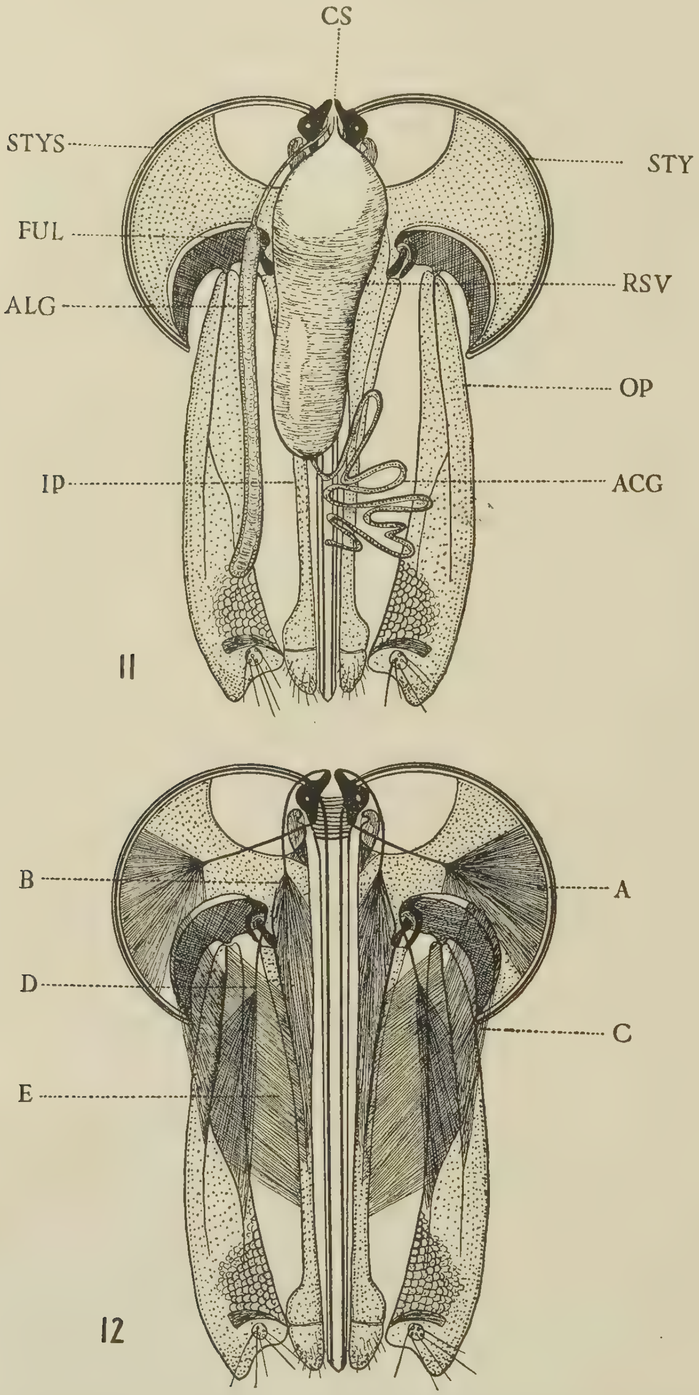
Zander studied the embryology of these gonapophyses and, according to him, the inner plates represent the ninth sternum, the outer plate the ninth tergum and the fulcral plate the eighth sternum.

The Sting Muscles.

The muscles which govern the movement of the stylets and their sheath may be classified as indicated below. An entirely comparable description of these muscles has been given by Ferrière (1924) in another Chalcidoid.

(1) *The muscles that swing the stylets and their sheath* at right angles to the body just before stinging. Of these there is one on each side. They have a very long tendon inserted on the anterior end of the rotatory process (figs. 12 & 13, B) and spread partly over the lower surface of the chitinous rib running along the inner plate and partly over the latter itself.

(2) *The sting is pulled back to its place* after stinging by one muscle on each side. It also has a long tendon inserted on the posterior extremity of the rotatory process, spreading like a fan and finally attached to the arm of the stylet-sheath (figs. 12 & 13, A).


CS
STYS
STY
FUL
RSV
ALG
OP
IP
ACG
11
B
A
D
C
E
12

Figs. 11–12.—(11) Poison glands. alg, alkaline gland; acg, acid gland; rsv, reservoir. For other lettering see Fig. 8. (12) The muscles of the sting. b, swings the sting at right angles to the body; a, pulls the sting back into its place; c & d, protrude the stylets out; e, withdraws the stylets.

(3) *The muscles that protrude the stylets* are two in number.

(*a*) One spreads below the chitinous rib of the outer plate and is inserted by means of a long tendon to the lower chitinised edge of the fulcrum just where it articulates (fig. 12, D).

(*b*) The other muscle extends from above the chitinous rib of the outer plate to the posterior extremity of the lamellate expansion of the inner plate (fig. 12, C).

The contraction of these muscles pulls the outer plates forward. This movement is communicated to the fulcral plate and thus to the stylets attached to it, resulting in the protrusion. This movement is also helped by the contraction of the longitudinal muscles of the abdomen.

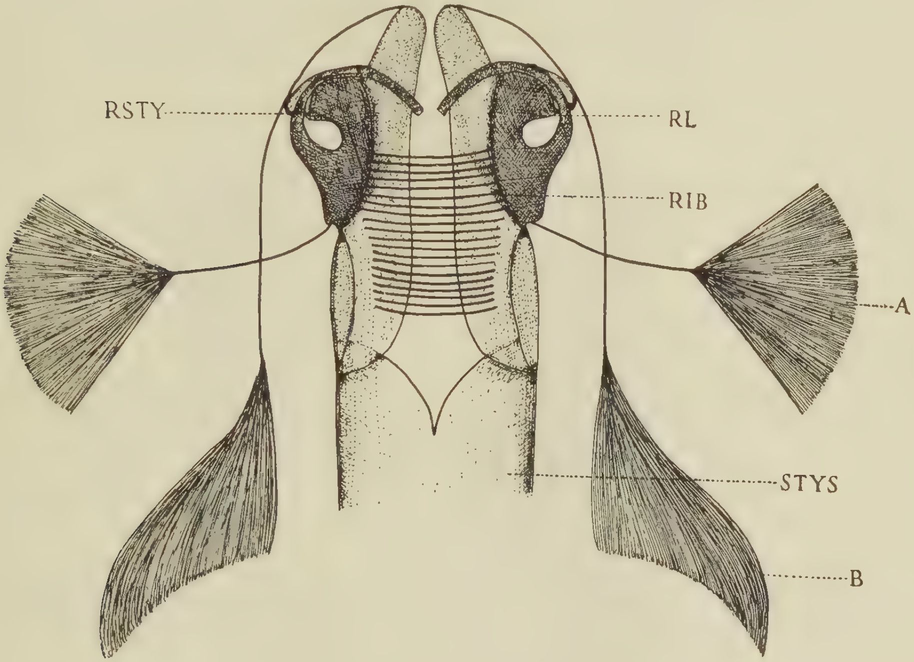


FIG. 13.—The base of the sting.
RIB, chitinous rib; RL, chitinous triangle; RSTY, root of the stylet; STYS, stylet-sheath; B, the muscle that swings the sting at right angle to the body; A, the muscle that pulls the sting back to its place.

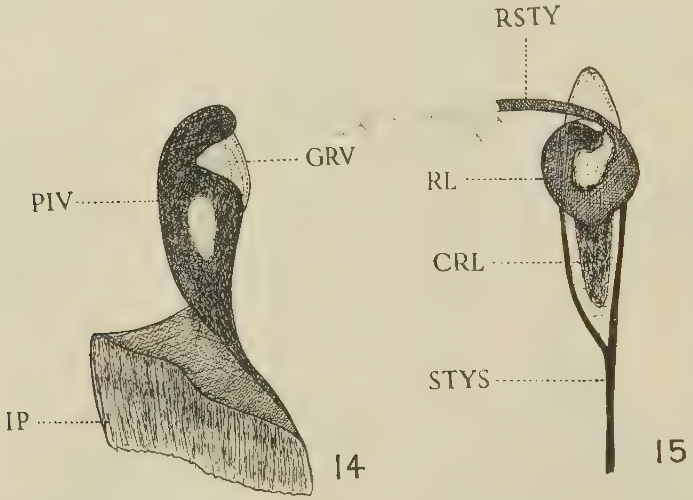
(4) *The muscles that withdraw the stylets* to their place are one on each side. They stretch from the lower side of the rib on the outer plate to the upperside of the rib belonging to the inner plate (fig. 12, E). The contraction of these muscles pulls the outer plate backwards. This movement is communicated to the fulcral plate and thus the protruded stylets are again withdrawn. This is also helped by the relaxation of the muscles of the abdomen.

(5) *The muscles that raise or lower the sting* while the insect is actually stinging. When the insect is stinging, the sting moves up and down. This movement is brought about by two muscles.

(*a*) One is inserted on the chitinous fork of the vagina on the one hand and on the anterior edge of the seventh sternite on the other (fig. 7, MUS). The contraction of this muscle causes the sting to move downwards. James (1926) found a similar muscle in *Harmolita*, but he is of the opinion that it helps in the expulsion of eggs. This does not appear to be its function in *Euchalcidia.*

(*b*) The other muscle stretches from the two arms of the seventh sternite and is inserted below on the outer plate behind the fulcral plate (fig. 7, MUS). The contraction of this muscle raises the sting.

(6) *The muscles that rotate the sting.* It was noticed that the sting, at the beginning of its insertion into the prey, rotates backwards and forwards. The same movement was also observed when the act of stinging is over and the insect starts to withdraw its sting from the prey. It is evident that this movement makes the penetration of the sting or its retraction much easier. There are no separate muscles to bring about this movement, but it seems that the alternate contraction of the two muscles (A & B, fig. 12) on each side causes this rotation.



Figs. 14–15.—(14) Pivoting process. GRV, groove; IP, inner plate; PIV, pivoting process. (15) The chitinous ring of the rotatory process. CRL, posterior process of the chitinous ring; RL, chitinous triangle; RSTY, root of the stylet; STYS, stylet-sheath.

The Sting Glands.

There are two sets of glands associated with the sting.

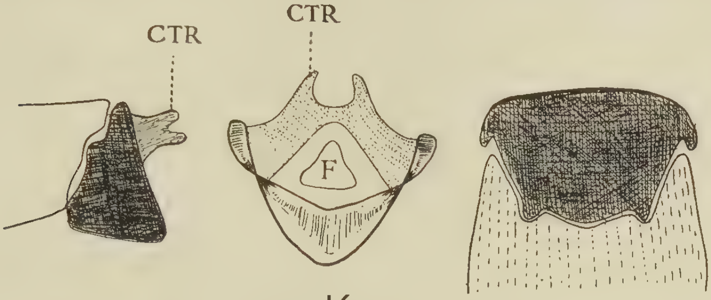
(1) The *acid gland* (fig. 11, ACG), of which there is only one, resembles in shape a Malpighian tubule, being narrow and much convoluted. It lies between the outer and the inner plate of each side. It opens directly into a very wide oval sac, the *reservoir* (fig. 11, RSV), which lies in the median line with its long axis parallel to that of the body. The reservoir stretches from the base of the sting to half as far back as the inner and outer plates. Its diameter is greater anteriorly. Its walls are very thin and its contents solidify in alcohol to form a wax-like substance. The reservoir opens by a very short slender neck into the base of the ovipositor.

(2) The *alkaline gland* (fig. 11, ALG) is an unpaired tubular gland lying on the left side of the reservoir and extending a long way behind it. Its diameter is small and it opens separately into the base of the sting by means of a very long minute neck.

The Male Genitalia.

The male genitalia consists of the penis and its two sheaths.

The *penis* (fig. 17, AD) is a cylindrical chitinous and membranous tube, tapering a little posteriorly. At its base it is strengthened on each side by a



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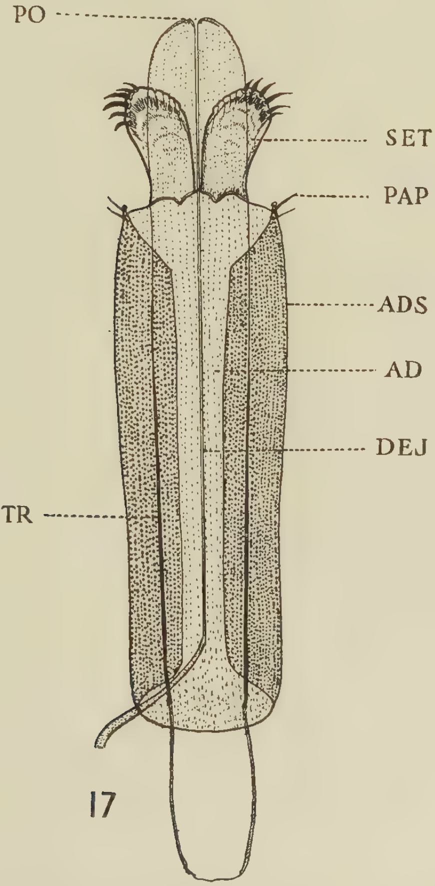

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FIGS. 16–17.—(16) Lateral, front and ventral view of the petiole. CTR, chitinous arms. (17) Male genitalia. AD, penis; ADS, penis-sheath; CTR, chitinous rib; DEJ, ejaculatory duct; PAP, palpi and sensory hairs; PO, the opening of the penis; SET, claspers carrying setae.

chitinous rib thinning out at the apex. These support the penis and enable it to retract into or protrude from the sheath (fig. 17, CTR). In the centre of the penis there is a tube, the ductus ejaculatorius (fig. 17, DEJ), which opens at its extreme posterior end (fig. 17, PO).

There are two *penis-sheaths*, one inside the other. The inner one is a chitinous cylinder incomplete dorsally. It envelopes the penis along its entire length (fig. 17, ADS). At its apex it carries two toothed, chitinous plates. These are the claspers and there is one on each side ventral to the penis (fig. 17). Each is concave on the dorsal surface and carries about six long, sharp, curved teeth, strongly chitinised and borne on its posterior surface. On each side of the posterior outer extremity of the sheath there is a small process carrying setae (fig. 17, SET). The muscles that move the penis in and out of its sheath are inserted obliquely between them.

The outer sheath is membranous and is attached at one extremity to the anterior edge of the inner sheath and the other to the dorsal and ventral anal papillae of the abdomen.

During copulation the penis is pushed out of the inner sheath, which is itself pushed out by the evagination of the outer sheath.

LIFE-HISTORY STUDIES.

I. *The Life-history of* Caryoborus pallidus *Oliv.*

Before studying the life-history of the Chalcid it was thought desirable to make a short survey of the life-history of the Bruchid. The eggs of *Caryoborus pallidus* Oliv. are dome-shaped and are laid on the surface of the senna pods. After six or seven days the egg hatches and the larva eats its way to the seed, inside which it penetrates. The larva consumes only one seed. On the average it is mature after 20 days and it then leaves the seed, after eating all its contents, and spins a cocoon, usually on the surface of the pod, where it now casts its skin and finally pupates. The whole life-cycle takes, on an average, 52 days. The minimum time taken by 43 individuals bred from egg to adult was 47 days, the maximum 57 days at 27° C.

To obtain enough Bruchid pupae to keep pace with the Chalcid, it was necessary to get a large quantity of pods as most of the seeds inside were already empty. Every effort to rear the Bruchid larvae on different seeds was unsuccessful as they died shortly after penetration. They can only live on senna seeds which were obtained with the insect material by sifting senna pods from boxes in the warehouse.

The Bruchid beetles were placed with fumigated senna in big glass jars. Moistened sultanas were added as food. The beetles laid their eggs on the pods which were changed every day. If the eggs are picked up carefully with a needle and each placed on a seed, the larva after hatching wanders about and does not penetrate the seed. If on the other hand the egg is stuck to the seed with gum, the newly hatched larva eats its way through, and although this method involved much time, yet it was the surest way of getting the pupae of the Bruchid free from mites (*Pediculoides ventricosus* Newport) which were a serious pest of the eggs of both the Bruchid and the Chalcid.

II. *Life-history of* Euchalcidia caryobori *Hanna.*

In the experiments carried out to investigate the life-history of the Chalcid, each pair was placed in a small glass tube with some of the Bruchid pupae with a small piece of sultana stuck on the cork of the tube. The sultana usually dries quickly, and, to avoid this, all the tubes were placed in a large glass jar covered with an airtight stopper and a piece of wet blotting-paper to keep the atmosphere damp. Humidity in the jar was about 75–80%.

Copulation.

Copulation takes place soon after the adults emerge. At first the male and the female do not seem to take much notice of each other. Then the male starts to pursue the female, which tries to escape, and, after a great effort, manages to climb on her back, with the tip of his abdomen not reaching to the apex of the female's and his legs holding her on both sides. His antennae are seen in constant motion on the surface of her head. Then he moves gradually backwards with his antennae still moving and at the same time lifting the front part of his body upwards to make an angle with the female. This angle increases and at the same time the female lowers the seventh sternite, and thus the male introduces his abdomen into it and the penis can already be seen far exserted. It is ultimately introduced into the copulatory pore at the base of the sting. Copulation lasts for a very short time from 5–20 seconds. Once the female is impregnated, she seems to reject all further attempts at copulation by pushing the male away with her hind legs. The eagerness of the male for copulation seems to increase in the sun or electric light.

Oviposition.

Although some individuals start to lay eggs on the day of their emergence, yet the average pre-oviposition period is three days and the maximum eight days. Before oviposition, the female wanders round the pupae in the glass tube feeling them one after the other with her antennae. Having found a suitable one, she feels with her antennae the place where she will insert her ovipositor. Finally she stands on the surface of the pupa and lowers her seventh sternite and also the stylets and their sheath, which is held in a groove on the posterior median part of the seventh sternite (fig. 7, GRV). The stylets and the sheath penetrate the cocoon and the claws are seen to cling firmly to the surface. During this period the palps of the inner plate are seen to project backwards at intervals owing to the contraction of the abdomen, which indicates that the stylets are moving up and down in the host. The insect does not move, its head is reflected backwards and the antennae folded and the wings lie flat over the body. It takes the female from 4–15 minutes to deposit one egg.

The eggs are laid practically anywhere on the host, but usually on the ventral side of the pupae in the thoracic region. Only one egg is deposited at each act of stinging, very rarely two. In the latter case the two eggs are seen lying side by side stuck together.

The eggs are many times thicker than the diameter of the sting and it seems that they are subject to great pressure during their downward course. Attempts to see the egg actually in the sting by killing the female during oviposition were not successful.

After egg-laying the female usually licks the puncture hole. This habit has been noticed by various authors observing different species of Chalcids. The association of this act with oviposition seems to be due to one of the two following causes.

(1) Either the female is closing the puncture,
(2) Or it actually licks and feeds upon the liquid it draws from the hole.

To determine the possible significance of (2), 20 females were kept separately in glass tubes each with some cocoons of the host but with no food. It was found on the average that these females lived four days. Now if the female actually feeds on the punctures it might be expected that its life will be shorter when kept without either cocoons or food. For this purpose 20 females were starved and the average length of life was again four days. But it seems that the number taken was not enough to draw any certain conclusion. It should be noted that the females used in this experiment were all of the same age, eleven days old.

The attitude of the female in moving her head in only one direction suggests that it is licking. If she is producing threads to close the puncture, the head would move in all directions during interweaving. Moreover, it was noticed that the act of stinging does not necessarily correspond to an egg-laying. It seems, therefore, that the female makes a puncture for drawing the liquid from the host.

The female does not instinctively lay each egg in a separate pupa. As many as ten eggs were seen in one cocoon, and yet seldom does more than one adult emerge from a single cocoon. Occasionally, but very rarely, two emerge from one cocoon, but only when two eggs have been laid on opposite sides of the host and the larvae did not meet. To determine what usually happens when more than one egg is laid in the host, it was necessary to rear the eggs on pupae extracted from their cocoons. Under these conditions they were reared successfully when the block watch-glasses and their covers were boiled in water to disinfect them. The cocoons containing the eggs were then opened and laid in the watch-glass. The cover was greased with vaseline to keep the chamber airtight and reduce evaporation.

When the female lays an egg in a cocoon already containing another egg, the eggs may be either of nearly the same age or one older than the other. In any case, after hatching one larva attacks the other, with results which the following experiments demonstrate :—

(1) Ten of the first-stage larvae each with a first-stage larva.
(2) Ten ,, ,, ,, ,, ,, second ,,
(3) Ten ,, ,, ,, ,, ,, third ,,
(4) Ten ,, ,, ,, ,, ,, fourth ,,
(5) Ten ,, ,, ,, ,, ,, fifth ,,
(6) Ten ,, second-stage larvae ,, ,, second ,,
(7) Ten ,, ,, ,, ,, ,, third ,,
(8) Ten ,, ,, ,, ,, ,, fourth ,,
(9) Ten ,, ,, ,, ,, ,, fifth ,,
(10) Ten ,, third-stage larvae ,, ,, third ,,
(11) Ten ,, ,, ,, ,, ,, fourth ,,
(12) Ten ,, ,, ,, ,, ,, fifth ,,
(13) Ten ,, fourth-stage larvae ,, ,, fourth ,,
(14) Ten ,, ,, ,, ,, ,, fifth ,,
(15) Ten ,, fifth-stage larvae ,, ,, fifth ,,
(16) Ten ,, full-grown larvae ,, ,, full-grown larvae.

The stages of the larvae were determined by the width of the head capsule. The results were as follows :—

(*a*) When the two larvae are of different ages, in 82%, the older larvae attacked and killed the smaller ones, in 9% smaller larvae attacked and killed the older ones, and in 9% both larvae were dead.

(*b*) When the two larvae are of the same age, in 35 cases out of 50 one attacked and killed the other, and in 15 cases both died.

It will be seen that the older larva attacks the younger one, inflicting a wound with the mandibles and sucking its body fluid. The opposite may also happen but more rarely, and in this case it seems probable that the attacking takes place when the older larva is quiescent before moulting for the succeeding stage. This is confirmed by the experiments in which the fifth-stage larva was accompanied by one in an earlier stage. In almost all cases the fifth-stage larva survived, probably because it has no further moults to pass through. After pupation there may be a renewal of attack. Sometimes both larvae are found dead, and this happens especially when they are of the same stage. If on the other hand one egg hatches before the other, the newly hatched larva sucks the egg if it happens to come across it, but as they are very small, the chance of attacking before the other hatches is remote.

When two fully grown larvae are placed together neither of them attacks the other as their feeding period is nearly over and there is then no competition.

The survival of one larva only is due to its being of such a comparatively large size, that the host provides only just enough food for one larva to reach maturity.

The Egg and the Period of Incubation.

The egg is sausage-shaped with one end a little broader than the other. Its colour is white and opaque owing to the yolk granules. The chorion is smooth, colourless, slimy and leathery. Its length is about 0·565 mm. and width 0·132 mm. (fig. 18).

The period of incubation at a constant temperature of 27° C. is a little less than two days. A short time before hatching, the larva can be seen through the transparent chorion to be wriggling inside. A colourless liquid appears between the chorion and the body of the larva. It moves from one pole to the other whenever the larva moves. This liquid seems to help the larva to draw its body from the integuments during eclosion. There is no special organ for eclosion, but the mandibles are used in making a slit in the chorion through which the larva escapes.

The Number of Eggs laid and the Influence of Age on Egg laying.

The average number of eggs of 55 females was 102 the maximum being 220. The usual number of eggs laid per day was 6. Sometimes none are laid, and this is due probably to the host being unsuitable for egg laying, as the number of eggs is seen to be nearly doubled the next day. Some time before the female dies, she lays an egg or two occasionally then finally stops laying altogether until she dies.

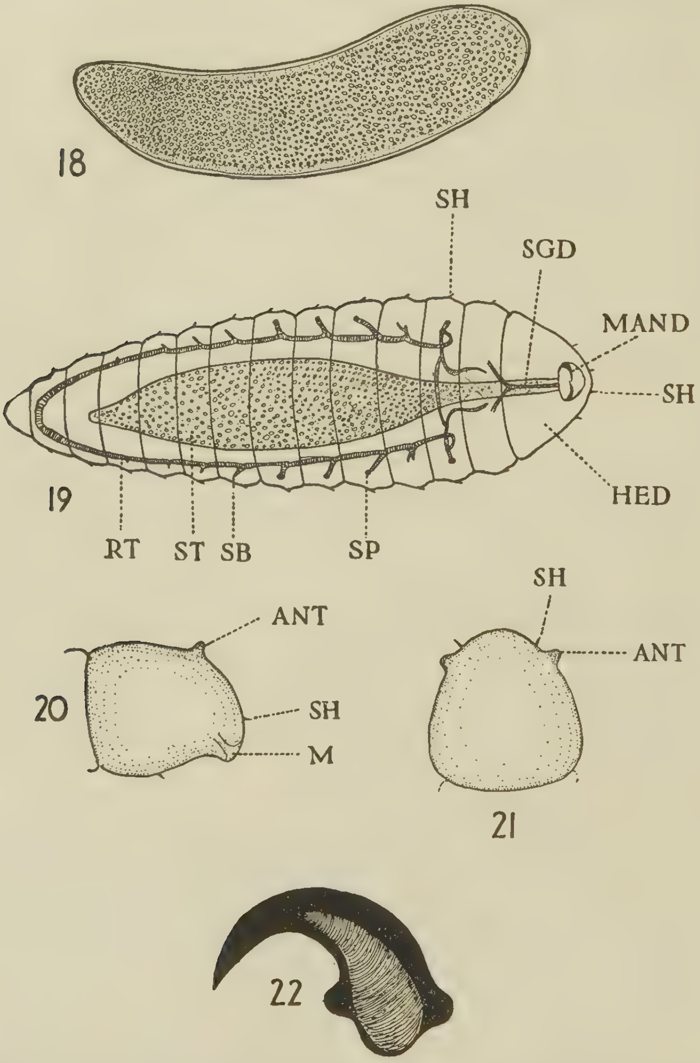
The Factors Influencing the Choice of Prey.

The behaviour of the parasite towards the host suggests that the latter possesses certain attractive qualities which exist either in the cocoon, in the pupa, or in both.

I. *Testing the qualities of the enveloping membrane as an attractant.*

(*a*) The *colour* of the cocoon does not seem to be of great importance as the female still lays its eggs through artificially coloured cocoons which were painted green, blue, white, black, yellow, red and light brown. Practically every colour was attacked, and although the number of eggs laid in the natural cocoons was more than those laid in the coloured ones, yet it seems that this is because they can penetrate them more easily than the ones covered with hard paint.

(*b*) *The texture and the form of the cocoon.* Experiments showed that the texture and form of the cocoon do not possess great attractive qualities. The female was still capable of laying eggs on the pupae if the latter are taken out of the cocoons and wrapped in cigarette paper, and by doing so the normal oval shape of the cocoon is not attained and yet this change of form does not seem to prevent the parasite from laying eggs.



Figs. 18–22.—(18) The egg. (19) First-stage larva, ventral view. HED, head; MAND, mandible; RT, right trunk; SB, budding spiracle; SP, spiracular trunk; SGD, salivary gland duct; SH, sensory hairs; ST, stomach. (20) Lateral view of the head. ANT, antenna; M, mouth. (21) Dorsal view of the head. (22) Dorso-lateral view of the first-stage mandible.

They refused to lay eggs in specimens wrapped in silver paper, but it seems that the sting could not penetrate it.

In other experiments the cocoons were given :—

(1) Empty.

(2) Filled with blotting-paper soaked in the body fluid of the host.

(3) Filled with coagulated egg albumen.

Not a single egg was laid, nor were they seen to sting these cocoons. The attractive qualities must therefore be sought in the pupa itself.

II. *The attractive qualities of the pupa.*

Eggs were deposited in cocoons containing dead larvae or pupae, but not so freely as on live pupae. For laying they prefer live pupae to live larvae and dead pupae to dead larvae. The percentage of mortality of the newly hatched larvae of the parasite placed on the larva of the host is very great, but this percentage is much reduced if the later stages of the parasitic larvae are placed on the larva of the host.

So it seems that the pupa when it is alive and to a less extent when dead exerts an attraction on the parasite. The exact nature of this attractant is unknown. Under a little pressure of egg-laying, the parasite can be made to lay eggs on bare pupae, dead or alive, but not on live larvae, although it can lay on them if confined in a cocoon. The reason seems to be that the pupa has a limited movement which enables the parasite to sting it easily, while the rapid movement of the larva will move the sting out of its course when in action.

The factors which attract the parasite could have been better studied if different species of Bruchid pupae that can be parasitised had been available. By accurate comparison of the exact qualities of the hosts on which attack depends, we can form an idea about the relation between the host and the parasite.

The Stages of the Larva.

Since the skin of the larva is colourless and the mandibles of microscopic size, it was impossible to see them unless they adhered to the surface of the larva. The number of moults was partly worked out by the actual observation of each moult and partly by measuring the width of the head capsule by an accurate scale having 656 divisions to one millimetre, and as the width of the head remains unaltered during each stadium, owing to the presence of the endoskeleton, it was possible to determine the number of ecdysis.

The First-stage Larva.

When the larva hatches its average width is 0·105 mm. and an average length of 0·23 mm. The width of the head is 0·109 mm. It is oblong and tapers a little posteriorly. Its colour is very pale yellow and transparent owing to the fat-body being little developed. The body is divisible into a clearly marked head (fig. 19, HED) and thirteen segments. The head is much broader than the body, relatively big, and nearly hemispherical in shape, tapering a little anteriorly. It carries on its dorso-lateral and anterior surface a pair of antennae (figs. 20 & 21, ANT) which under the microscope look like a pair of domes with a small bristle in the centre. Below the antennae there is a pair of minute hairs. A similar pair is also found on either side behind the mouth on the anterior ventral surface of the head. The mandibles are similar to those of the fully grown larva, only much more curved (fig. 22).

On each side of each of the body segments there is one hair carried on a dome-like protuberance which under the microscope resembles that of the antennae.

The alimentary canal can hardly be seen owing to its transparency, but if the larva is fed on a mixture of the crushed pupa and solid borax carmine its outlines can be determined. The pharynx is a very narrow tube leading to the oesophagus which enlarges behind it to give rise to the stomach, which is an elongate sac ending blindly in the eleventh segment (fig. 19, ST). The salivary duct of each side joins to form a common duct (fig. 19, SGD) directly after they enter the head. This duct shows taenidia along its walls and opens on the floor of the mouth.

The respiratory system consists of two lateral tracheal trunks (fig. 19, RT) one on each side, joined by a transverse commissure anteriorly in the second segment and posteriorly in the eleventh. In front, the anterior commissure gives off two branches directed forwards and the posterior gives off a pair directed backwards. Four pairs of spiracles are present on the mesothorax and the first three abdominal segments respectively. On the outer side of each lateral trunk in the metathorax and abdominal segments four, six and seven, there are outgrowths which are the developing spiracular branches.

This instar lasts (at 27° C.) from two to three days, and at its conclusion the larva is about 0·45 mm. long and it becomes slightly brownish owing to the food contained in it. In other essential details, it is similar to the fully grown larva.

The Second-stage Larva.

The larva is darker in colour and more opaque than the preceding stage. The width of the head is 0·16 mm. and the length 0·83 mm. The spiracular branches which were budding in the metathorax, fourth, fifth, sixth and seventh abdominal segments are more complete and open into spiracles on the corresponding segments, but the calibre of these branches is much smaller than those formed in the first stage. The duration of this instar (at 27° C.) is only one day.

The Third-stage Larva.

The third-stage larva is 1·8 mm. in length, the width of the head is 0·229 mm. The duration of this stage is one day at the above temperature.

The Fourth-stage Larva.

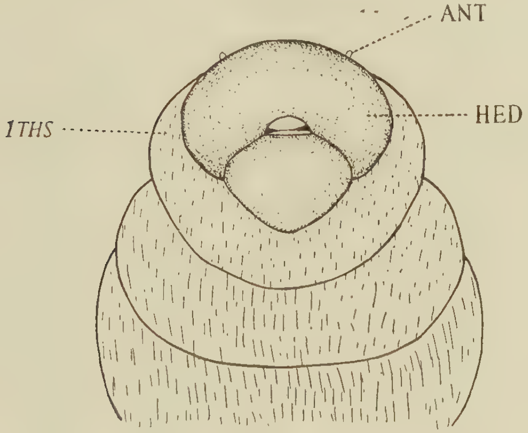
The width of the head capsule is about 0·29 mm. and the length of the body 1·8 mm. The duration of this stage is one to two days.

The Fifth-stage Larva.

The fifth stage is the last stage. The width of the head capsule is 0·42 mm. and its length about 4·2 mm. The duration of this stage is from 3–4 days at 27° C.

Coloration.

The fully grown larva is bright brown at first and becomes white later owing to the formation of the fat body underneath the skin. The stomach can be seen occupying almost the whole interior as a large brownish bag with a greenish tint due to its contents. The last segments are whitish because the stomach does not reach so far back.



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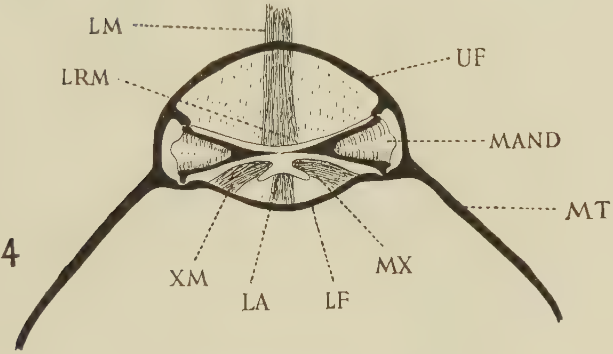

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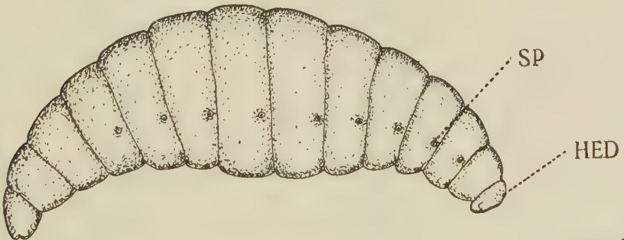

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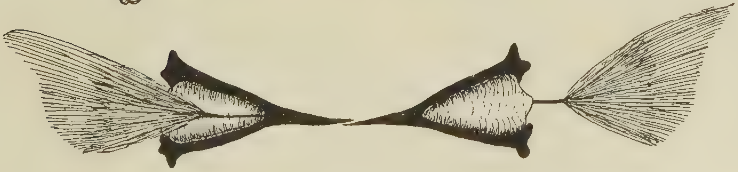

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FIGS. 23–26.—(23) Front view of the head. ANT, antenna; 1THS, first thoracic segment; HED, head. (24) The endoskeleton of the head. (Dorsal branch)—LA, labium; LF, lower fork; LM, lip muscle; LRM, labrum; MAND, mandible; MT, main trunk; MX, maxilla; XM, maxillary muscles; UF, upper fork. (25) Last-stage larva. HED, head; SP, spiracle. (26) Mandibles of the last stage and the muscles that move them.

THE EXTERNAL MORPHOLOGY.

The larva is fusiform (fig. 25), its greatest thickness being in the middle, and tapering gradually towards both extremities. It is divisible into the head and the body segments.

The *head* is much narrower than the first segment of the abdomen and is circular in outline with a sort of chin below (fig. 23). The antennae are similar to those of the first-stage larva, only bigger. No legs or leg-like processes are present. The integument of the head, though not heavily chitinised, is much thicker than that of the body.

The *endoskeleton of the head* consists of two heavily chitinised trunks which proceed from its outer surface below the horizontal axis and bend upwards and inwards (fig. 24, MT). Near the centre of the head, each gives rise to two forks, a lower one proceeding in nearly a horizontal direction to meet and fuse with the corresponding forks of the other side (fig. 24, LF). The upper fork is bent upwards and inwards to meet that of the other side (fig. 24, UF), so it forms together with the lower fork a semicircle. The two trunks and their forks run a little below the integument.

The mouth-parts. Owing to the parasitic habit of the larva, the mouth-parts have been much modified.

The *mandibles* lie horizontally in the mouth in the form of half a cone, heavily chitinised, with their apex drawn into a fine point (fig. 26). The base of the cone is grooved and occupied by the muscles that move the mandibles. The apex of each mandible is directed inwards so as to touch the other in the median line. The base is directed outwards and articulated to a process on the upper fork (fig. 24, MAND). On the lower fork there is a socket which receives a process from the base of the mandible. Two muscles which move the mandibles are inserted on the head capsule in a fan-like manner.

(1) The adductor muscle is inserted by a long tendon to the base of the groove (fig. 26).

(2) The abductor muscle is inserted near the apex of the cone, and owing to the position of the fulcrum it pulls the mandible outwards.

The *upper lip* is a membrane stretching between the upper forks and partially covering the mandibles (fig. 24, LRM). It has vertical muscles which are inserted on the head capsule and move the lip in a vertical plane (fig. 24, LM). Its free edge is covered by fine sensory hairs.

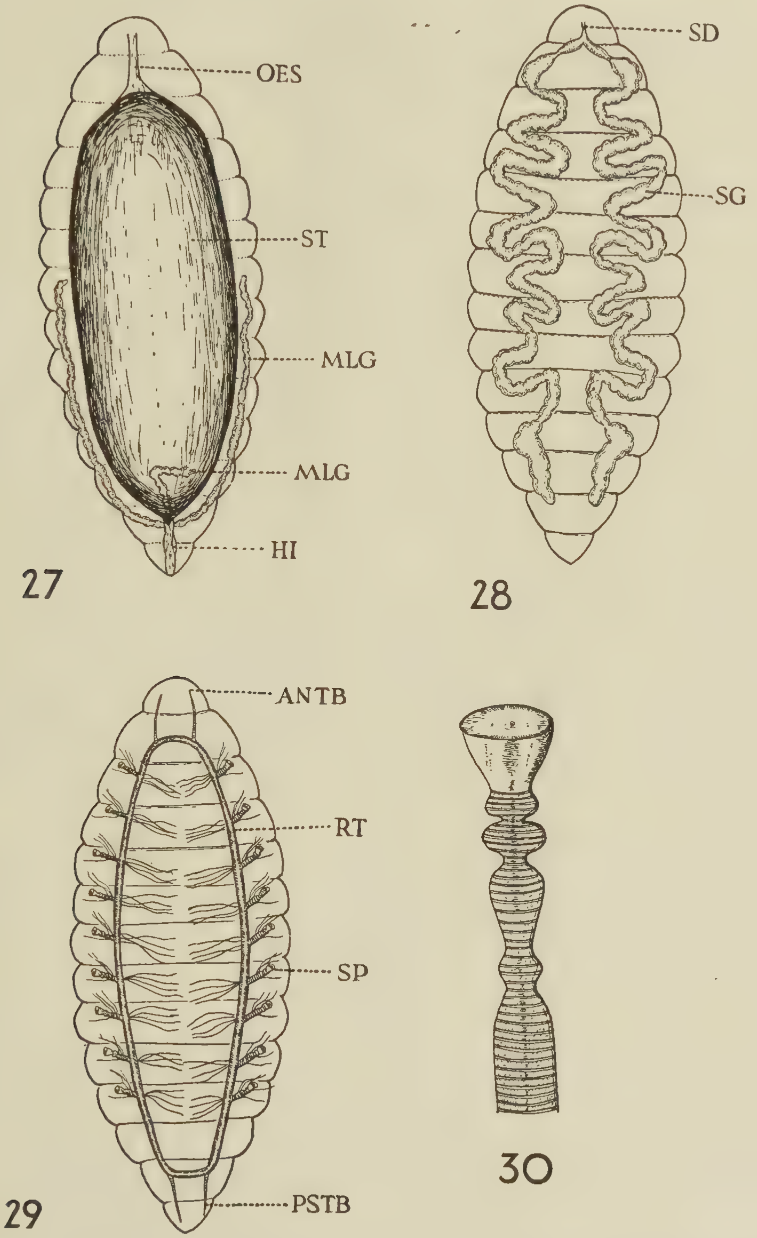
The *maxillae and the labium* are also membranous and fused together basally. They extend transversely just below the mandibles. The maxillae (fig. 24, MX) are triangular in shape. On both sides they embrace the labium which is simply a semicircular flap. In well-stained specimens the oblique muscles which move the maxillae (fig. 24, XM) and the vertical muscles which move the labium can be seen (fig. 24, LA). Some sensory hairs are located on their edges.

The *body segments.* The body consists of 13 segments without any differentiation between the thorax and the abdomen. No legs are present. The nine spiracles lie each in a slight depression on the sides on the anterior border of the corresponding segments (fig. 25, SP).

THE INTERNAL MORPHOLOGY.

The Digestive System.

The digestive system is very simple and consists of a wide conical mouth on the antero-ventral surface of the head. This leads to the *pharynx* (fig. 27), which is a wide short tube. If a larva of the first stage is placed on a slide with



Figs. 27–30.—(27) Digestive system of the larva. HI, hind gut; MLG, malpighian tubes; OES, oesophagus; ST, stomach. (28) Salivary glands. SD, salivary duct; SG, salivary gland. (29) Respiratory system. ANTB, anterior branch; PSTB, posterior branch; RT, right respiratory trunk; SP, spiracle. (30) Spiracle of the larva.

a drop of water and a cover-slip on top, the muscles that move the pharynx can be seen in action, as the larva keeps alive for a considerable time. Three sets of these muscles can be recognised.

(1) A series of dorsal muscles stretching between the dorsal wall of the pharynx and the dorsal wall of the head capsule.

(2) The second set of muscles extend from the ventral surface of the pharynx to the ventral surface of the head.

(3) The third series stretch from the lateral side of the pharynx to each side of the head capsule.

It seems that these three sets of muscles widen the diameter of the pharynx considerably, which is then narrowed up again by means of circular muscles causing strong peristaltic movement. In feeding, the larva is seen to take in semi-liquid food by means of the mouth-parts and this travels in globules through the pharynx and oesophagus to the stomach.

The *oesophagus* is very short and opens into a very wide sac (fig. 27, OES), the stomach has a constant peristaltic movement and entirely fills the whole body-cavity. It stretches from the metathorax anteriorly to the eighth abdominal segment posteriorly where it is connected to the hind intestine, though there is no opening in the stomach to connect them together (fig. 27, ST). A thin membrane separates their contents and thus the larva does not pass excreta until it stops feeding. When, however, full growth is attained the larva stops feeding, the extremity of the stomach becomes perforated and the excreta passes out in a series of pellets. In all cases where the larvae were reared exposed on the host, they left the host and lay without movement for a few hours, after which they passed all the excreta.

In the hind intestine, three regions can be recognised : an anterior narrow region, a wider one and a narrow hind region (fig. 27, HI).

The *salivary glands* are two in number and attain an enormous size. They lie on both sides of the stomach, forming a loop in almost every segment during their course (fig. 28, SG). The two short canals of each gland unite into a common duct just after they enter the head. This common duct has taenidia on its walls and runs under the oesophagus and pharynx to open on the floor of the mouth.

The Malpighian tubes are three in number and open in the anterior part of the hind intestine. Two of them are very long (fig. 27, MLG) and extend forwards on both sides under the salivary glands for nearly half the length of the stomach. The third one is much shorter and is directed backwards and lies below the stomach. They are constricted at intervals along their course.

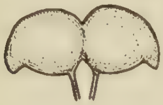
The Respiratory System.

The respiratory system of the full-grown larva consists of two longitudinal trunks on both sides connected anteriorly in the prothorax and posteriorly in the ninth abdominal segment by transverse commissures, each in its turn gives two branches directed to the head and the tenth abdominal segment respectively (fig. 29, ANTB & PSTB). Each lateral trunk is connected by spiracular branches to the nine spiracles (fig. 29, SP). Opposite the root of each spiracular branch there are a few other very fine branches directed ventrally. Other fine branches are given off from the spiracular branch and are directed dorsally. The atrium of the spiracle is funnel-shaped and opens into the trachea, which is not uniform in calibre as it has four dilations along its course (fig. 28).

The Nervous System.

The nervous system consists of the cerebral ganglion and the ventral nerve cord.

The *cerebral ganglion* is in the form of two compressed spheres lying one beside the other (fig. 31) in the anterior part of the prothorax above the oesophagus. Parker also found it in a corresponding position in different Chalcids, and Miall and Hammond in a Chironomous larva. In the full-grown larva, the imaginal head is formed in relation to the cerebral ganglion; thus each antenna



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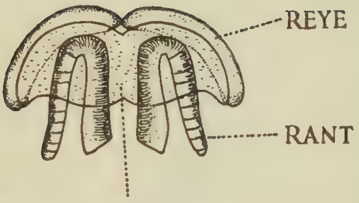

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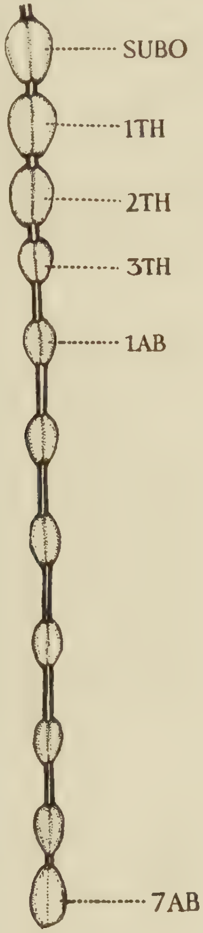

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FIGS. 31–33.—(31) The brain. (32) BRN, brain; RANT, rudiment of antenna; REYE, rudiment of the compound eye. (33) The nerve cord. SUBO, sub-oesophageal ganglion; 1TH–3TH, thoracic ganglia; 1AB–7AB, abdominal ganglia.

(fig. 32, RANT) is seen lying folded like an elbow on the front surface of the brain and the compound eyes arise on its upper surface (fig. 32, REYE).

The *sub-oesophageal ganglion* is oval (fig. 33, SUBO) and connected to the brain by two short connectives.

The first two *thoracic ganglia* are larger than the third, which is nearly equal in size to the abdominal ganglia (fig. 33, 1, 2 & 3 TH).

The *abdominal ganglia* are seven in number. They are also oval, but of nearly uniform size with the exception of the last one which is a little larger. Every ganglion is connected to the one preceding by two longitudinal commissures which are very short in the thorax and longer in the abdomen, with the exception of the last which is very short.

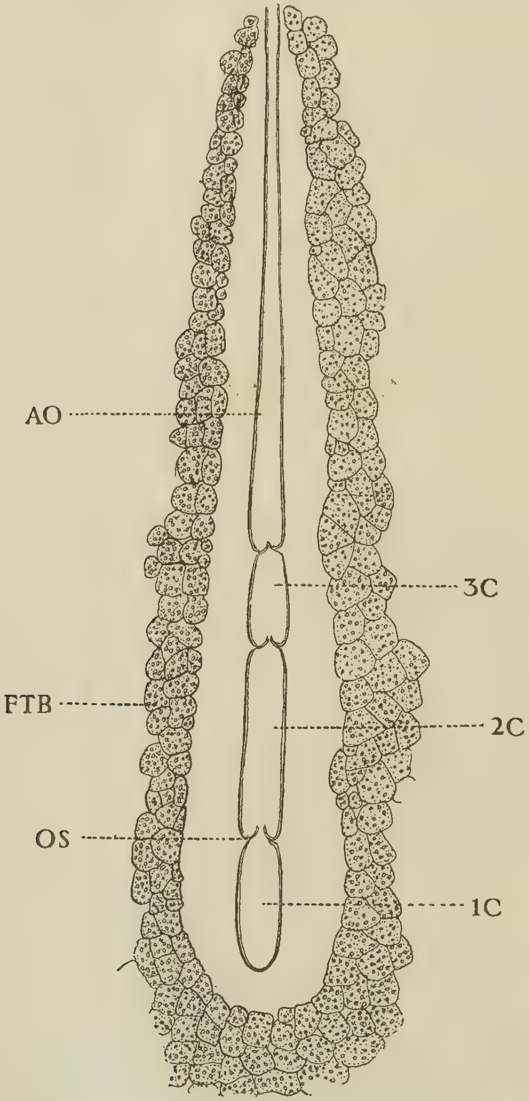

Fig. 34.—The dorsal vessel of the larva.
AO, aorta; FTB, fat bodies; 1C–3C, chambers of the heart; OS, ostium.

Each ganglion gives off two principal nerves one on each side, the last abdominal gives rise to three pairs of conspicuous nerves.

The Circulatory System.

The dorsal vessel lies directly below the integument on the mid dorsal line and is flanked on each side by a fat body (fig. 34, FTB).

The *heart* consists of three chambers located in the third to the eighth abdominal segments. The first chamber (fig. 34, 1c) is tubular and oblong in outline; the second is nearly twice as long as the first (fig. 34, 2c); the third is almost as long as the first chamber.

The *aorta* runs dorsally and narrows till it enters the head. There is a pair of ostia between each chamber.

The best way to dissect the heart is to leave the larva for twelve hours in 70% alcohol to harden it and to prevent the shrinking of the integument when the larva is opened.

The Muscular System.

If a full-grown larva is cut longitudinally in a dorso-ventral plane, the alimentary canal and fat body is removed, and the remainder stained in borax carmine, two series of muscles, one dorsal and one ventral can be distinguished (fig. 35, DS & VS). The spiracles lie between them (fig. 35, SP). Each series consists of five longitudinal muscles. In the anterior and posterior part of the body the muscles approach one another and are reduced in number; thus in the prothorax there are four bands in each of the dorsal and ventral series, and in the mesothorax, there are only four bands in the dorsal series. In the eighth abdominal segment there are only four bands in the ventral series and two in the ninth. In the tenth segment there is only one band in each of the dorsal and ventral series. The upper band of the ventral series extends to the head, where

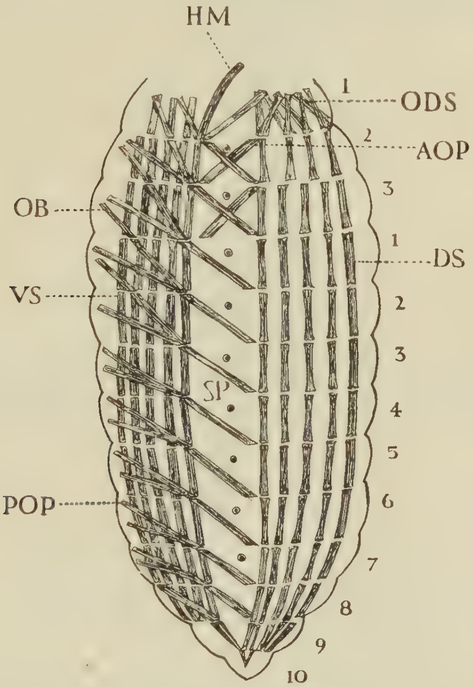

FIG. 35.—The muscles of the larva cut vertically into two halves (the right half is shown).

AOP, additional oblique muscles; DS, dorsal set; HM, muscle proceeding to the head; OB, oblique muscle; ODS, additional muscles; POP, branching of the posterior oblique muscles; SP, spiracle; VS, ventral set.

it is attached to the endoskeleton (fig. 35, HM). The upper series belonging to the same segment has four additional bands which are attached anteriorly to the head (fig. 35, ODS).

In addition, there are also some oblique muscles. Each one starts from the lower band of the dorsal series and runs forwards and downwards along one segment until it reaches the upper band of the ventral series and then its course differs in different segments thus : the first oblique muscle crosses two segments, the second, third, fourth and fifth bifurcate (fig. 35, OB), the anterior fork crosses two additional segments and the posterior fork crosses one segment only. The sixth, seventh, eighth, ninth and tenth oblique muscles (fig. 35, POP) also bifurcate, but each furca traverses only one segment. In the eighth abdominal segment there is only one oblique muscle which crosses the four bands of the ventral series and ends at the termination of the lower band of the same series belonging to the seventh abdominal segment.

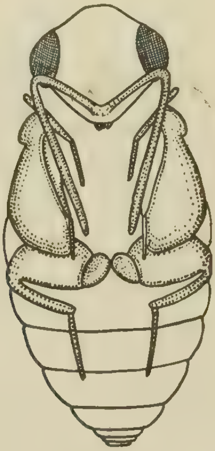

Fig. 36.—Ventral view of the male pupa.

In the three thoracic segments, there is also an oblique muscle which is perpendicular to the other oblique muscles (fig. 35, AOP).

The Last Stages of the Full Grown Larva.

When a larva reaches maturity it passes its excreta and undergoes a brief period of quiescence during which it becomes whitish in colour, and in shape narrow anteriorly and broader posteriorly. This period lasts about twelve hours during which it prepares itself for pupation. The wings, the antennae, the legs and the eyes can be seen through the skin which appears to be separated from the larva by a fluid which helps the pupa to withdraw from the skin. This skin is now cast off and the pupa appears. No cocoon is spun.

THE PUPA.

The pupa after casting the larval skin is white in colour and no black pigment is seen. It remains so for three or four days, then the black pigment starts to appear in spots usually on the pronotum first and then the mesothorax. The head is flexed downwards on to the prosternum. The eyes are whitish at first and then they get darker and darker. A rough outline of the adult segments can be seen; the petiole is marked by a slight constriction. On the frons there is a swelling on which the scape of the antennae are borne. Each funicle is directed inwards and backwards on the ventral surface. At first its segments are not clear. Below the swelling on the frons is the triangular labrum flanked on both sides by the rudiment of the mandibles. The tibia and the tarsi of the front legs are present on the inner side of the antennae. Those of the middle legs on its outer side. The coxa, femur, tibia and tarsus of the hind leg are very prominent, but the coxa is comparatively small. The divisions of the tarsi are blurred. All these structures are glued to the ventral surface of the body.

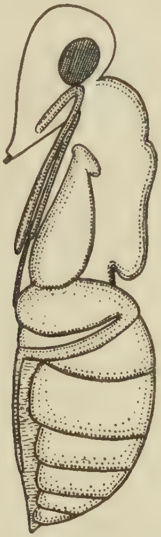

Fig. 37.—Lateral view of the male pupa.

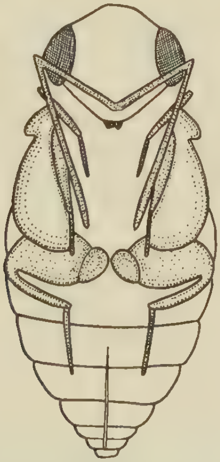

Fig. 38.—Ventral view of the female pupa.

The male pupa (figs. 36, & 37) can be distinguished from the female (fig. 38) by the antennae. In the male the angle between the scape and the funicle is rounded and in the female the angle is very sharp. In later stages of the pupa there is a longitudinal chitinised streak along the ventral posterior median line which indicates the position of the sting in the female. In addition the female pupa is usually bigger than the male.

With advancing age more and more pigment is deposited until the pupa becomes metallic black and the different parts of the body are differentiated.

THE LIFE-HISTORY AT 27° C.

The total period of the life-history differs in the sexes.

(1) In the male, the length of the life-history of 123 males was worked out as follows :—

TABLE No. 1.

Stage.	Minimum.	Mean.	Maximum.
Egg . . .	1 day	2 days	3 days
Larva . . .	7 days	8 ,,	11 ,,
Pupa . . .	7 ,,	9 ,,	11 ,,
Total life . .	18 ,,	19 ,,	24 ,,

(2) In the female the length of the life-history of 104 females was worked out :—

TABLE No. 2.

Stage.	Minimum.	Mean.	Maximum.
Egg . . .	1 day	2 days	3 days
Larva . . .	8 days	10 ,,	14 ,,
Pupa . . .	7 ,,	9 ,,	11 ,,
Total life . .	20 ,,	21 ,,	26 ,,

It may be noticed that the pupal stage ends when the adult starts to walk. Under natural conditions, where the pupa is contained within the host cocoon, the latter precludes observation of the commencement of the adult stage. In the present experiments the host cocoon had been removed and this difficulty did not arise.

The Influence of Food on the Total Period of Life-History.

It was thought desirable to find whether the food of the larvae has any influence on the total life-history. Thus they were fed on

(1) The pupa of the host.
(2) The larva of the host.

For 90 males, the average length of life of the larva reared on the pupa was 8·6 days, the pupa 9 days and the total length of life-history 19 days.

Another 50 males were bred on the larva of the host, the average length of the larval life was 9 days, the pupa 8 days and the total life-history 19 days.

From this it seems that in the first case the life of the larvae was short and that of the pupae long, although the total life-history in the two groups was the same.

The Emergence of the Imago.

The pupae after reaching maturity are seen in exposed specimens to move their legs and antennae, and when the adult starts to move they clean their antennae and head by means of the front legs and the thorax, wings and abdomen by means of the hind legs.

Specimens that were not exposed are seen to leave the host cocoon by eating their way out with the mandibles. A circular hole is made in one of the poles of the cocoon. Through this they push their heads and then their front legs, finally they crawl out. It seems that it takes a very long time for individuals to emerge from the cocoon. This was shown by calculating the total life-history until emergence from the cocoons for 50 males and 50 females. In the latter the average was 25 days and the former 23 days. By comparing this result with those in tables 1 and 2, it seems that it takes each about 4 days from the time they start to move inside the cocoon until they emerge from it.

The Duration of the Life of the Imago.

The average length of the life of the imago worked out from 60 males was 50 days, the maximum being 75 days, and the average duration of 56 females was 51 days and the maximum 82 days.

Parthenogenesis.

To ascertain whether parthenogenesis takes place, female pupae were placed each in a separate watch-glass until emergence. They were divided into two groups each consisting of 50 females.

(1) In the first group each female was placed in a tube with a male, a sultana, and five Bruchid pupae which were replaced every day, 383 individuals were produced, 195 females and 188 males or the sexes roughly in equal number.

(2) In the second group each female was placed alone in a tube as above mentioned, 319 individuals were produced, all males.

Thus the fertilised female produces both sexes in equal numbers and the unfertilised female produces only males.

ACKNOWLEDGMENTS.

In conclusion, I wish to express my indebtedness to Professor J. W. Munro and Mr. O. W. Richards for their continuous help and advice throughout the course of the work. I am also grateful to Mr. C. Potter for giving me facilities to visit London warehouses for material.

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NEW EXOTIC HYDROPTILIDAE

By Martin E. Mosely.

[Read 4th April, 1934.]

With Fifty-eight Text-figures.

The European Hydroptilidae are now fairly well known, but our knowledge of exotic forms is still very meagre. Thanks to the work of Mr. K. J. Morton and of Dr. Nathan Banks, a fairly large number of North American species have been described, but in Central and South America, India and the Far East, the family is practically unrecorded.

A few species have been described from New Zealand, thanks mainly to the efforts of trout-fishermen who have visited the Islands and have collected material there, but the Hydroptilid fauna of Australia and Tasmania has been entirely neglected hitherto.

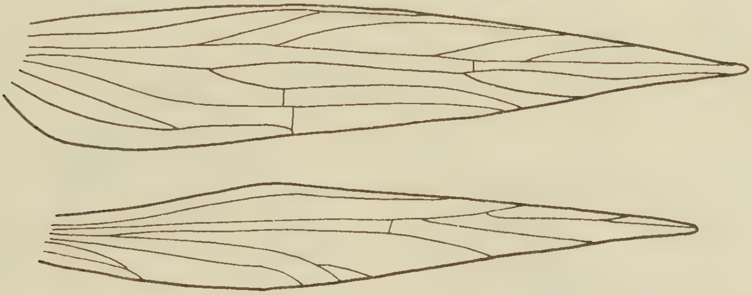


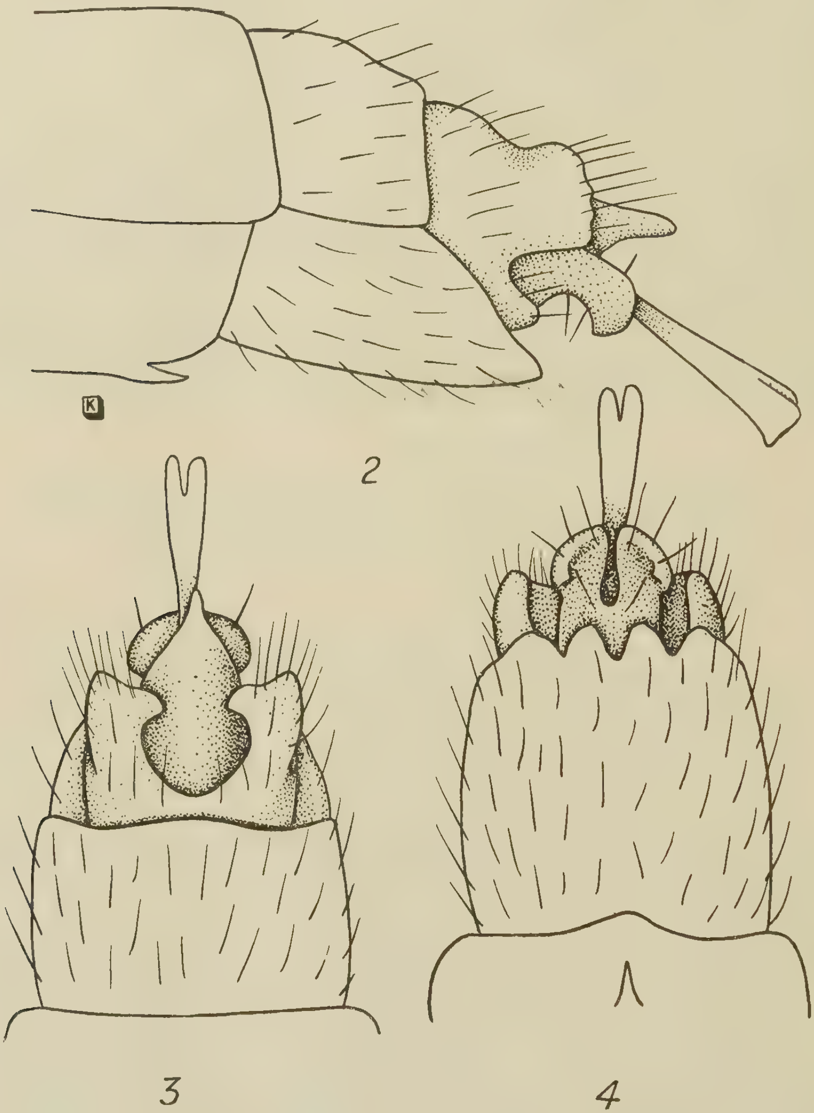
Fig. 1.—*Orphninotrichia maculata* sp. n. ♂. Wings.

It is therefore with considerable interest that I have examined a small collection from these two regions made by Dr. R. J. Tillyard, and I am much indebted to him for allowing me to include descriptions of the new genera and species in this paper.

The material from the Argentine and Chile was collected by Dr. F. W. Edwards and the remaining species here described were found amongst the British Museum accessions and in my own collection.

Most of the new genera described in this paper have been erected mainly on characters of neuration. Unfortunately in the Hydroptilidae, the neuration is generally very obscure. The naming of the veins and forks is always a matter of conjecture in this family and probably no two specialists would agree to name them alike. I do not propose to enter the ranks of the theorists and have consequently contented myself with giving figures of the neuration as it appears to me, and am leaving the naming of the various parts to those who may be interested in this form of speculation.

I have placed an Australian and a Tasmanian species in the genus *Hydroptila* with some hesitation, and should not be surprised if more abundant material should warrant new genera being erected to take them. This remark applies equally to an Argentine species placed in *Oxyethira*. This insect is represented by a single example which differs slightly from the typical *Oxyethira* form in neuration and more particularly in the genitalic pattern. Until more material is available, it seems to me preferable to adopt this course rather than to create a new genus to receive it.



Figs. 2–4.—*Orphninotrichia maculata* sp. n. ♂. 2 genitalia lateral, 3 dorsal, 4 ventral (terminal dorsal segment omitted).

AUSTRALIA AND TASMANIA.

Orphninotrichia gen. n. Fig. 1.

The genus is erected to take a single Australian species in which the neuration differs considerably from that of all other Hydroptilid genera, as may be seen on reference to fig. 1.

The wings are rather broad at the base and acuminate at the apices. Ocelli present; antennae 32-jointed, rather stout, basal joints scarcely longer than the others; maxillary palpi as is usual in the family with the first and second joints very short, third, fourth and fifth of about the same length; labial palpi rather broad; spurs 0, 2, 4. There is a short process to the penultimate ventral segment.

Genotype, *Orphninotrichia maculata* sp. n.

Orphninotrichia maculata sp. n. Figs. 1–4.

Head very dark fuscous; antennae 32-jointed, dark fuscous; legs fuscous; wings both anterior and posterior dark fuscous, anterior with a small patch of snow-white hairs on the post-costal margin about midway, extending into the fringe; there are a few dark spots scattered over the wing, extreme apex black, fringes fuscous.

Genitalia, ♂. Apical margin of the ninth segment deeply excised nearly to its base with a heart-shaped excision; the segment, from above, is consequently bifurcate, each branch truncate and sinuous at its apex with the inner apical angle somewhat produced; outer margins of the segment straight; from the side, the outer margin is deeply excised in its lower half; from above, in the excision of the segment may be seen a semi-transparent triangular upper penis-cover, apex produced and pointed; beneath this is a long and slender penis considerably protruded with a dilate and bifurcate apex; beneath the penis is a lower penis-cover consisting of a pair of large strongly chitinised processes, from the side with rounded, hooked and down-turned apices; from beneath, the apices are broadly and obliquely truncate and fringed with strong hairs; margin of the eighth ventral segment with three acute excisions so that there are two triangular projections formed at its centre; from the side, the lower margin of this segment is strongly produced and the whole ventral segment is rather more strongly chitinised than is usual. A short acute process to the penultimate ventral segment.

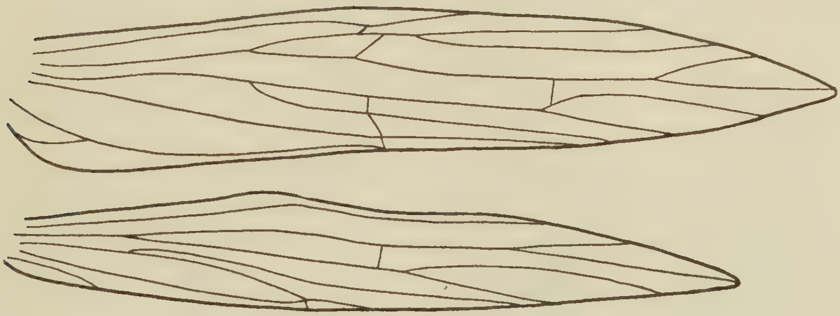


Fig. 5.—*Xuthotrichia ochracea* sp. n. ♂. Wings.

Length of anterior wing, ♂, 2·5 mm.

Australia : Hornsby, N.S.W. 31.viii.1916 (*R. J. Tillyard*).

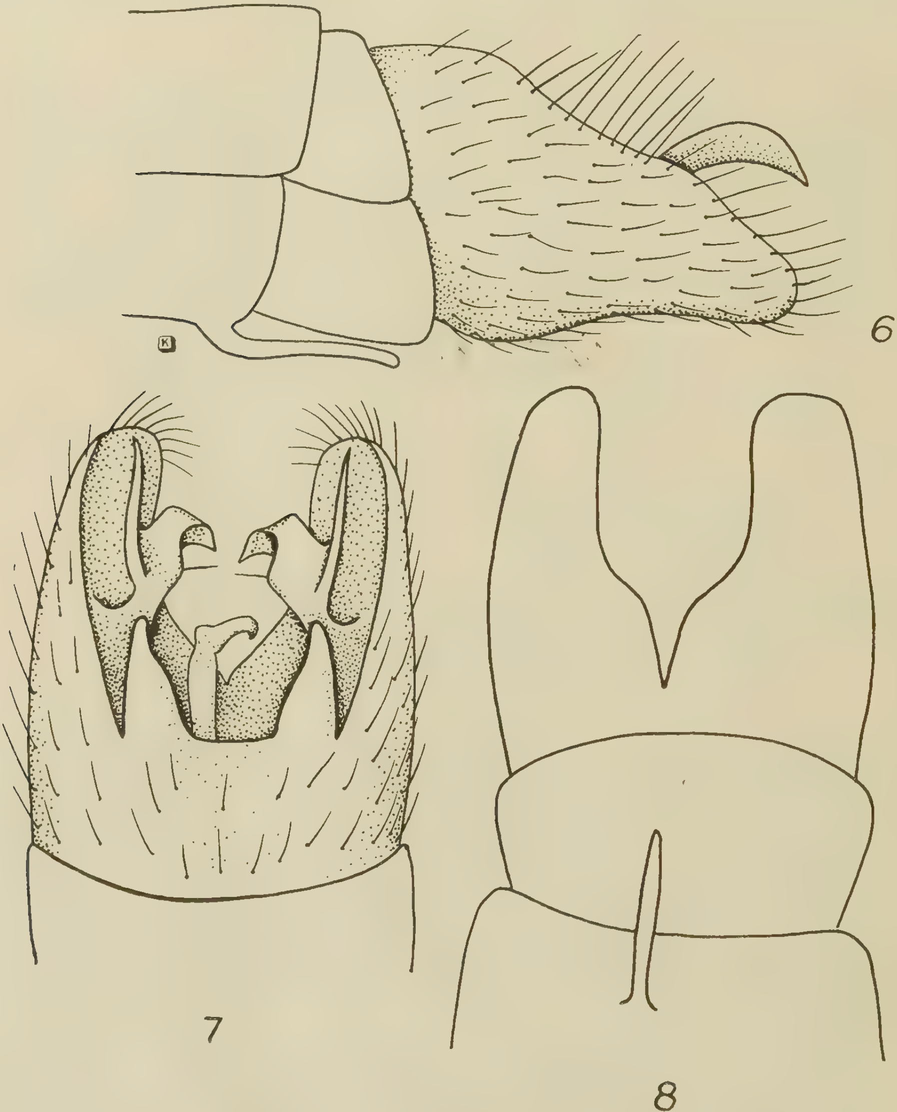
Type ♂, in the collection of Dr. R. J. Tillyard, is mounted in balsam but with the wings mounted dry.

Xuthotrichia gen. n. Fig. 5.

The genus has been erected to take a group of four Australian species bearing a close resemblance to one another in the shape, neuration and coloration of the wings. For the neuration, reference should be made to fig. 5.

Apices of the wings acute but not produced; ocelli present; antennae long, about 41-jointed, very pale in colour in all four species, basal joint short and rounded, only slightly longer than each of the others; spurs 0, 3, 4; a long and slender ventral process to the anti-penultimate segment.

Genotype, *Xuthotrichia ochracea* sp. n.



Figs. 6–8.—*Xuthotrichia ochracea* sp. n. ♂. 6 genitalia lateral, 7 dorsal, 8 ventral segments.

Xuthotrichia ochracea sp. n. Figs. 5–8.

Head covered with fuscous and very pale hairs giving a general appearance of light bronze; antennae pale cream with a section, towards the apex darker, tips cream: about 40 joints. Thorax streaked with two pairs of vertical silver bars on a fuscous ground, diverging towards the posterior margin. Wings, anterior yellowish-fuscous with a large rounded white patch at the centre towards the apex; fringe along the costal margin dark fuscous nearly to the apex when the colour is interrupted by a short length of bright gold, apical fringe fuscous; fringe along the posterior margin long and cream-coloured; posterior wing cream-coloured with darker fringe.

Genitalia, ♂. The terminal segment forms a strongly chitinised capsule with slightly concave upper surface; the terminal dorsal margin is widely excised and at the base of the excision arise two pointed processes widely separated from each other; the lateral margins are produced in wide concave processes with rounded apices; from the side, the capsule is broad at the base with the upper margin sloping slightly downward to a rounded apex; lower margin slightly sinuous, nearly horizontal. From beneath, the segment is deeply excised, the excision narrowing at the base to a deep cleft. From the inner surface of each lateral process towards the base, there arises a bifurcate process, outer apical angle produced in a long, very slender posteriorly directed finger, inner angle of the process with the apex bent downward and inward; there is a single spine midway on the inner margin of each process directed horizontally inwards. From the side, only the process of the outer apical angle can be seen and it appears as a broad down-curving sickle-blade; penis with a broad hook at the apex directed at right angles towards the right; ventral process long and slender, from the side slightly sinuous.

Length of anterior wing, ♂, 3 mm.

Australia: Brisbane, 30.ix.1920.
Type ♂ in Dr. R. J. Tillyard's collection.

Xuthotrichia eskensis sp. n. Figs. 9–12.

Head covered with cream-coloured hairs; antennae 41-jointed, very light fuscous; palpi light fuscous. Anterior wing yellowish with several dark fuscous blotches, four along the costal margin extending into the fringe, the fourth, at the extreme apex spreading slightly round to the lower margin; there are also two pairs of short linear brown marks, one pair towards the base of the wing with the lower line rather nearer the apex than the upper and the second pair towards the apex with the lower line again nearer the apex and almost based on the lower margin; posterior wing pearly-grey with pearly-grey fringes. Legs light fuscous, posterior pair heavily fringed with pearly-grey hairs.

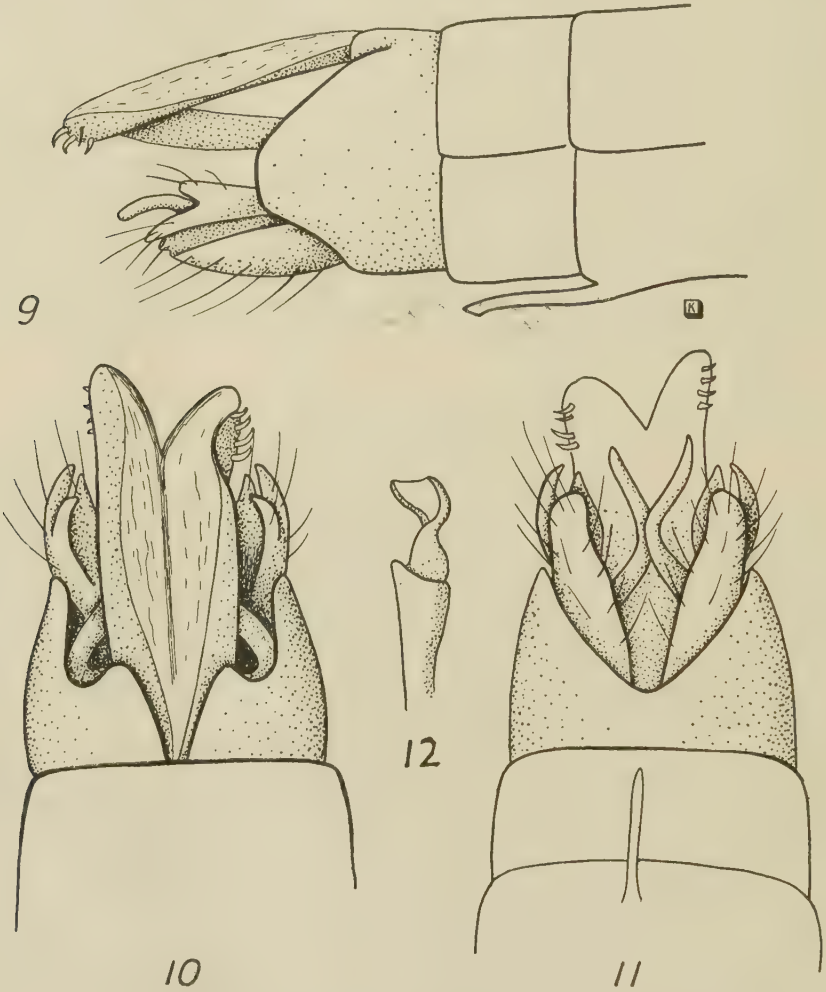
Genitalia, ♂. From above, the apical margin of the last dorsal segment very deeply excised. In the excision is seen a large bifurcate asymmetric plate, the left fork being larger than the right; attached to the plate are chitinous strengthening ribs supporting the outer edges and the centre; at each apical lateral margin and slightly beneath it is a group of strong claws; the edge of the plate on the right side is slightly twisted, perhaps aberrantly so that the claws can be seen from above; those on the left are concealed by the plate. Penis very long and slender, apex dilated but not clearly visible. Intermediate appendages strongly chitinised, dark and slender, only the bases visible from above and the apices, which curve slightly downward, from the side; from beneath, the bases are widely separated; they approach each other and slightly overlap at the centre and diverge at their apices. Inferior appendages rather broad, each dividing into four branches; from beneath, the lowest of these branches is long and broad with a broad rounded apex; the apices of two more slender branches may be seen above it; the fourth branch which is small and incurving can be seen only from above and the side. Ventral process long and slender, from the side, slightly sinuous.

Length of anterior wing, ♂, 3 mm.

Australia: Esk, Queensland, 9.vii.1916.
Type ♂ in the collection of Dr. R. J. Tillyard.

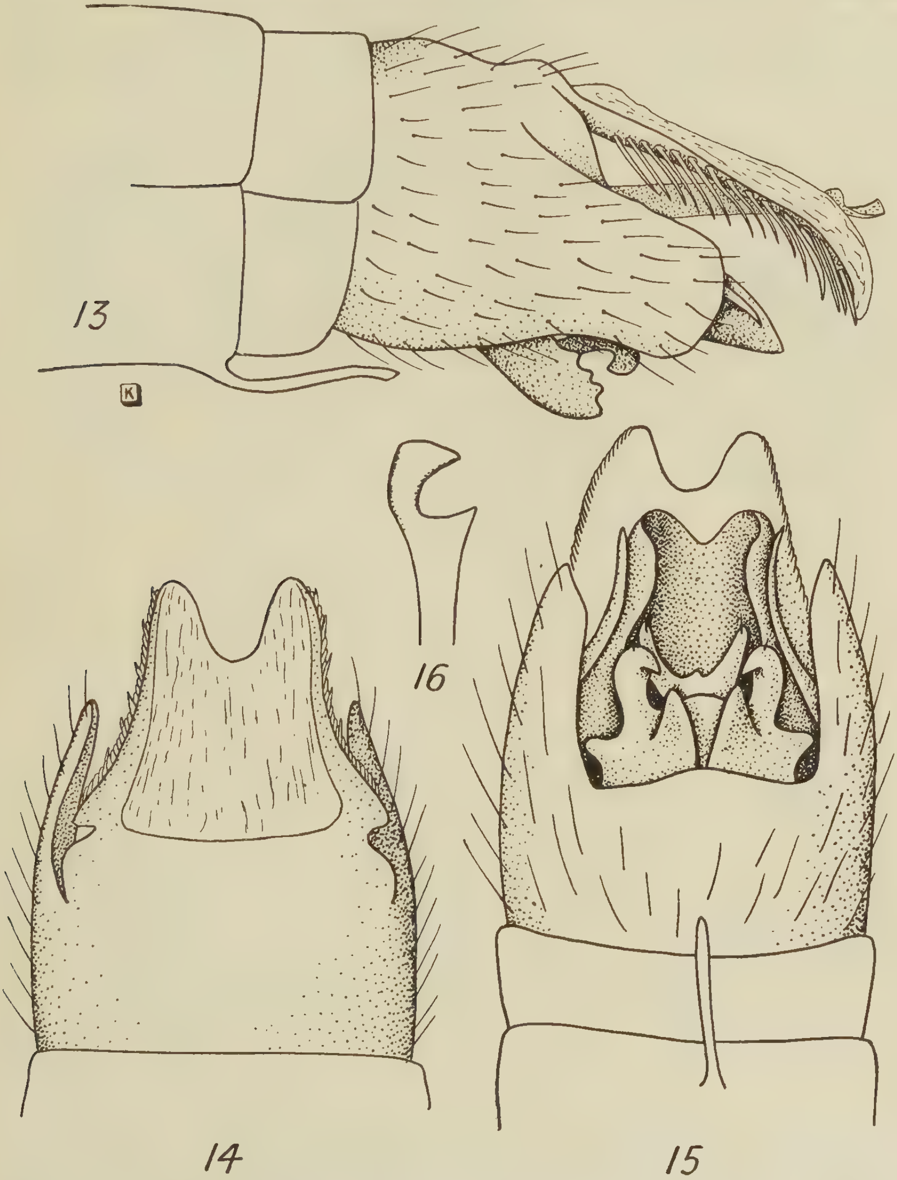
Xuthotrichia fimbriata sp. n. Figs. 13–16.

Head dark fuscous with a few cream-coloured hairs; antennae cream-coloured; palpi and legs ochraceous. Wings, anterior, pale fuscous, fringe near the base of the costal margin dark, then rather paler with a dark patch followed by a nearly white patch towards the apex which is black as is also the apex of the posterior wing. Other markings indistinct; one anterior wing missing in the type.



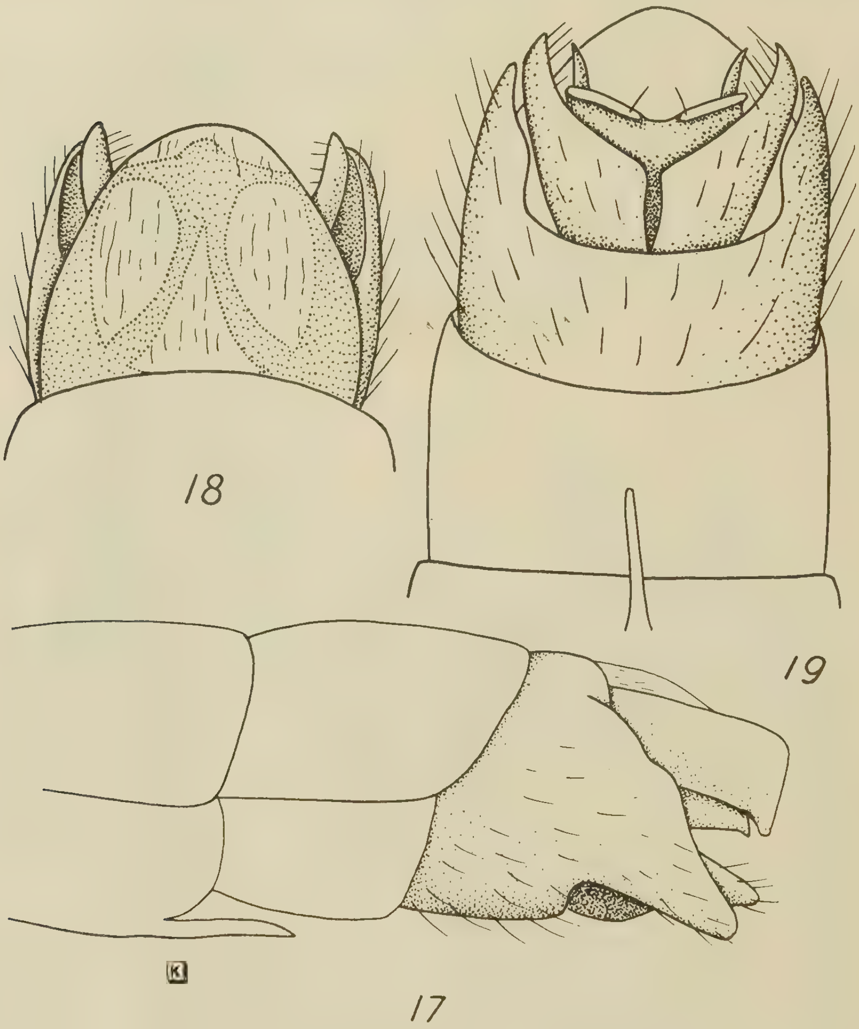
Figs. 9–12.—*Xuthotrichia eskensis* sp. n. ♂. 9 genitalia lateral, 10 dorsal, 11 ventral (penis not shown), 12 apex of penis.

Genitalia, ♂. The ninth segment much protruded, from above appearing as a somewhat square, strongly chitinised shining plate, slightly concave towards the centre of its upper surface; from the side, the apical margin is much extended posteriorly, narrowing slightly to the rounded apex. There is a large dorsal plate, wide at the base, narrowing to a deeply excised apex, lateral margins with fringes of long stout spines attached to the more strongly chitinised edgings. The penis, which can be seen in the cleft of the dorsal plate and also from beneath, terminates in a wide falcate apex with a semi-circular excision in the apical margin situated to one side and rendering the apex asymmetric; beneath the penis is a membranous lower penis-cover which is hood-shaped, outer edges turned slightly under; at the outer sides of this cover are two long slender spines, with their bases widely divergent, approaching each other slightly towards their centres, apices directed tailwards. Inferior appendages three-branched; from the side, the lowest branch is stout with the upper margin strongly serrated; from beneath it is short and conical; the second branch is strong, hooked as seen from beneath, apex curling inwards



Figs. 13–16.—*Xuthotrichia fimbriata* sp. n. ♂. 13 genitalia lateral, 14 dorsal, 15 ventral (penis not shown), 16 apex of penis.

and downwards; from the side, the apex is dilated in a broad downwardly directed hook; the upper or third branches, from beneath, are short, slender and widely divergent, arising from a common broad base with a slight triangular projection between them, apices each armed with a bristle; these third branches from beneath appear almost as a separate process; the outer margins of the appendages from beneath are produced towards their bases in angular projections. Terminal ventral segment very deeply excised, the base of the excision very wide and slightly produced at the centre of its margin. Ventral process long slender and slightly sinuous as seen from the side.



Figs. 17–19.—*Xuthotrichia simplex* sp. n. ♂. 17 genitalia lateral, 18 dorsal, 19 ventral (penis not shown).

Length of anterior wing, ♂, 2·5 mm.

Australia: Heathcote, N.S.W., 26.viii.1916 (*R. J. Tillyard*).
Type ♂ in the collection of Dr. R. J. Tillyard.

The specific name, *fimbriata,* has reference to the heavy fringes of spines bordering the dorsal plate.

Xuthotrichia simplex sp. n. Figs. 17–19.

Head tawny with light tawny hairs (possibly faded); antennae pale cream-coloured; palpi and legs ochraceous. Wings, anterior, tawny with scattered groups of dark upright hairs, costal fringe dark near the base of the wing, then there is a light patch nearly to the apex followed by a short stretch of light gold just before the apex where the fringe is much darker; there is a gold spot at the extreme apex of the wing with a dark one immediately behind it and another gold spot behind this, somewhat towards the posterior apical margin; posterior wing fulvous with the apex slightly darker.

Genitalia, ♂. Ninth segment much protruded, in the single example (which may be teneral), only lightly chitinised; from the side, the segment is broad at the base, much produced at the apex to form a broad downwardly pointing finger; there is an angular excision along the lower margin; from above, there is a rounded membranous dorsal plate strengthened by rather broad chitinous curved strips, the bases of which are widely separated; they then approach each other and are united towards the apical margin in a rounded patch from which two short horizontal bars extend to the outer margin; from the side, the apex of the plate is turned downwards and the appearance is that of a nearly rectangular process; beneath is a pair of narrow, posteriorly directed and widely separated plates which in the side view are seen to terminate in acute downwardly directed apices; penis much retracted with an undilated apex directed towards the left; beneath the penis, seen from beneath, is a lower penis-cover in the form of two horizontal plates with the apices somewhat rolled over, joined at the centre by a membrane. Inferior appendages from beneath, widely divergent, terminating in acute apices. Margin of the terminal ventral segment deeply and widely excised. Ventral process long and slender.

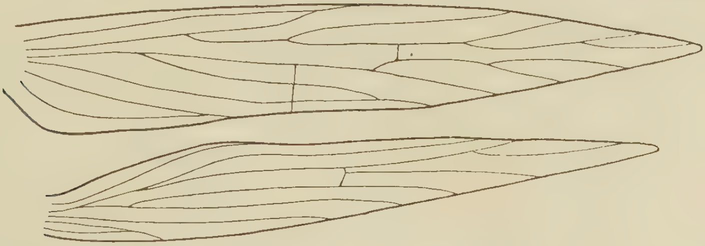


Fig. 20.—*Hydroptila incertula* sp. n. ♂. Wings.

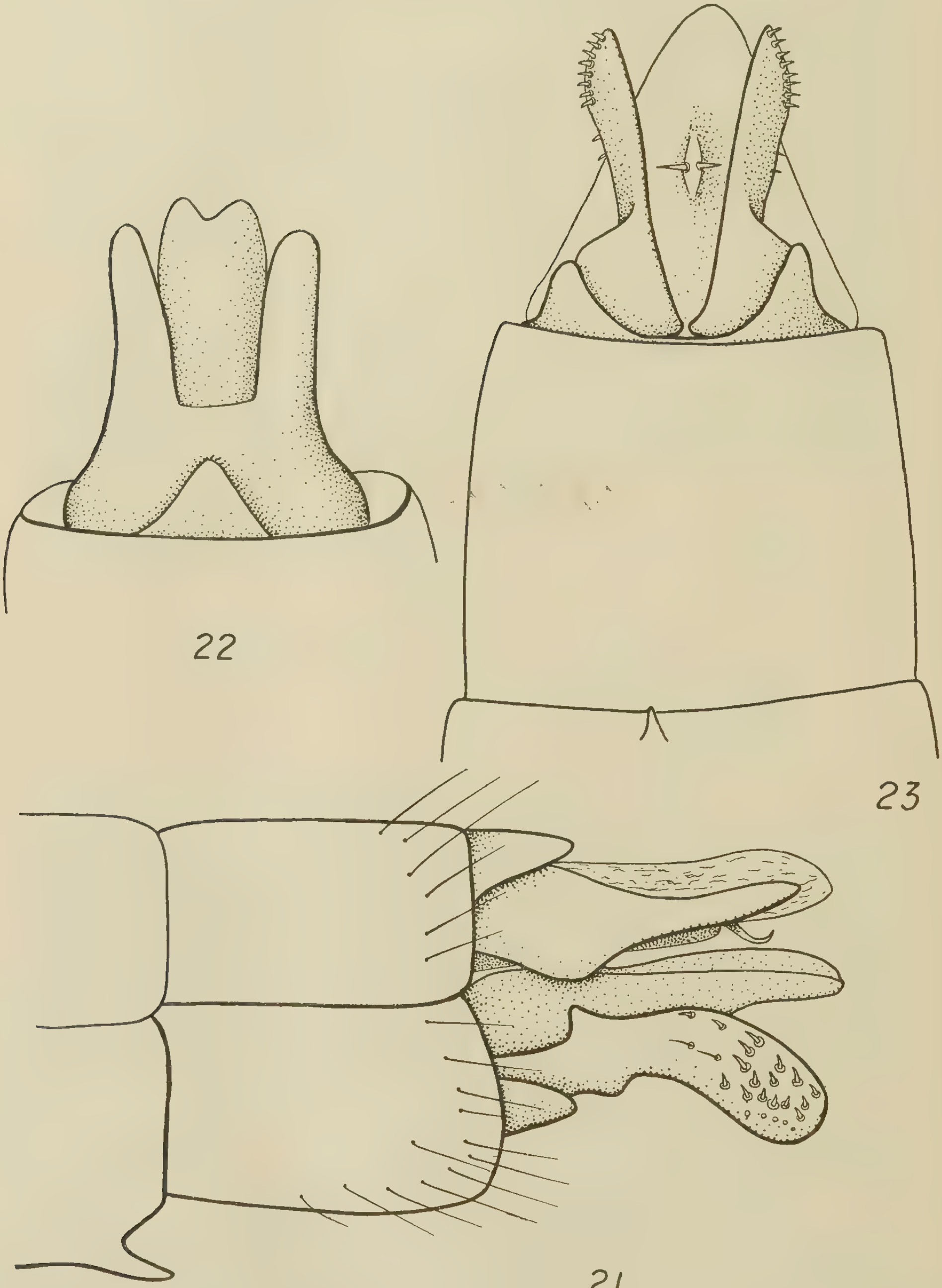
Length of anterior wing, ♂, 3 mm.

Australia : Warwick, Queensland, October.
Type ♂ in the collection of Dr. R. J. Tillyard.

Hydroptila incertula sp. n. Figs. 20–23.

Head partly destroyed, antennae 30-jointed, palpi missing. Wings rather more pointed than in the European species.

Genitalia, ♂. The margin of the terminal dorsal segment is produced in an acute triangle; beneath it is a lightly chitinised plate the apex of which is cut out in a deep U-shaped excision in the centre of which may be seen a membranous plate, probably an upper penis-cover, with an excised apical margin; beneath this is the penis with a hook towards the apex, bent to the left at right-angles; beneath the penis is a membranous



Figs. 21–23.—*Hydroptila incertula* sp. n. ♂. 21 genitalia lateral, 22 dorsal (inferior appendages and lower penis-cover omitted), 23 inferior appendages and lower penis-cover ventral.

lower penis-cover with a short ventral keel carrying two strong spines projecting laterally. Inferior appendages large, somewhat dilated at the apices which are furnished with stout, outwardly directed peg-like spurs; seen from the side, towards the base, along both the upper and the lower margins are two angular projections opposite each other. The margin of the terminal ventral segment is cut away in a deep semi-circular excision. A short ventral process.

Length of anterior wing, ♂, 2·5 mm.

AUSTRALIA : Brisbane.

Type ♂ mounted in balsam in Dr. R. J. Tillyard's collection.

There are several ♀♀ labelled " Brisbane " some of which may belong here. I have, with some hesitation, placed this species in *Hydroptila*. Unfortunately the head of the single ♂ has been partly destroyed so that I am unable to ascertain whether scent-organs are present or not. Possibly, when more material is available, it may be necessary to erect a new genus to receive it.

Hydroptila tasmanica sp. n. Figs. 24–27.

Head dark fuscous bearing two wide and rather shallow scent-organ caps at the back; antennae 29-jointed, pale fuscous. Wings long and very acuminate at the apices, anterior, light fuscous with a white patch along the fringe towards the apex, remainder of the fringe fuscous; posterior, light fuscous; palpi and legs light fuscous.

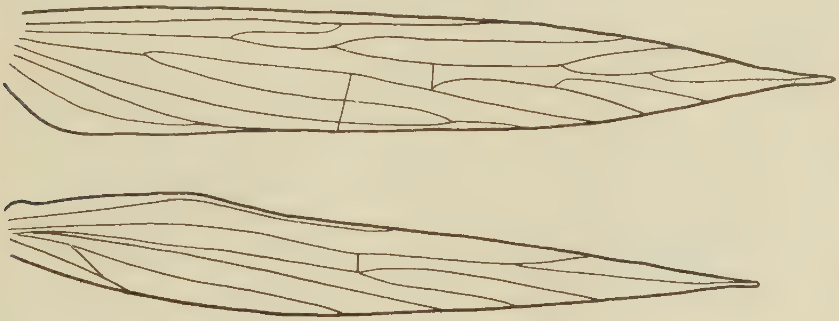
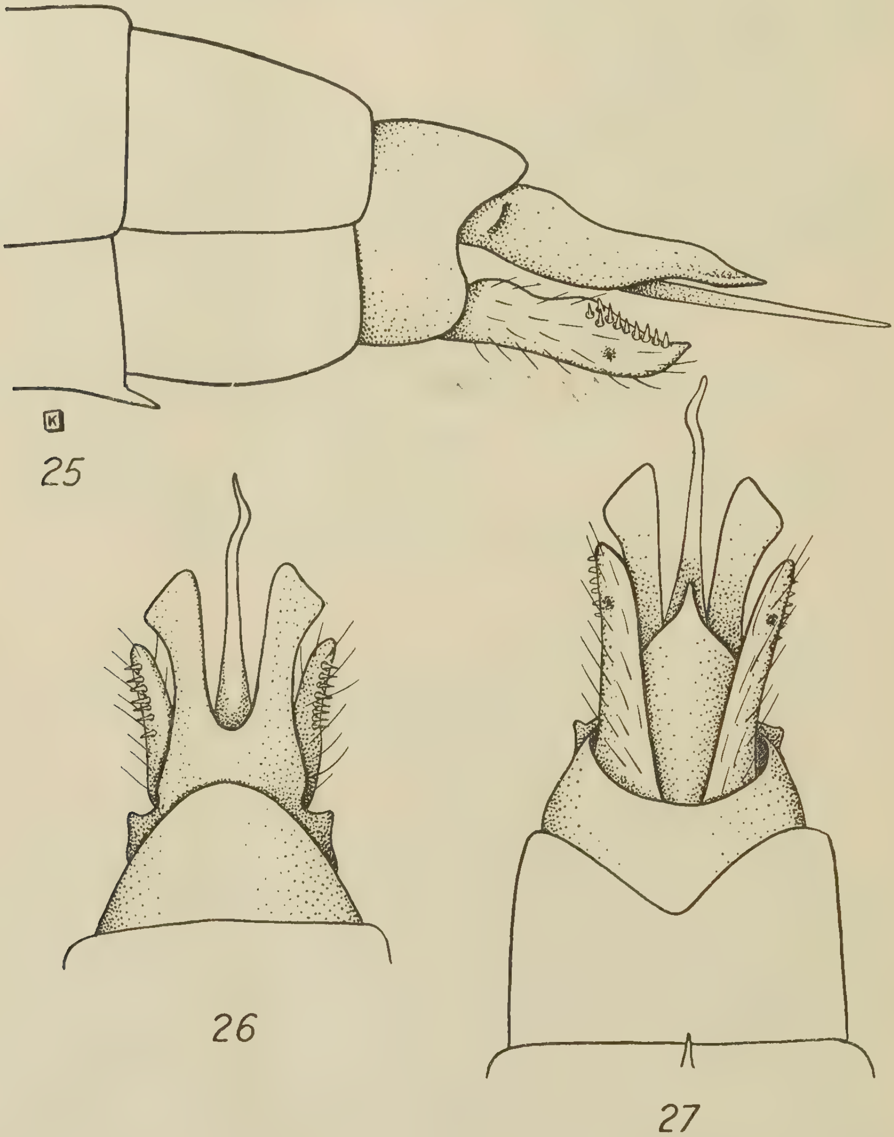


FIG. 24.—*Hydroptila tasmanica* sp. n. ♂. Wings.

There are two females in the collection from the same locality taken on the same date which may perhaps be associated with this species. In these, the basal joints of the antennae are pale, then there is a long dark fuscous stretch, then a short pale stretch and finally the few apical joints are dark.

Genitalia, ♂. The anterior margin of the ninth dorsal segment is strengthened with a strongly chitinised band which is divided at the centre by a vertical impressed line (not shown in the figure in order to avoid confusion of detail); from the side, the apical margin is strongly excised; there is a long bifurcate dorsal plate, broad at the base, each fork dilated at its obliquely truncate apex; at the base of the plate along the lateral margins there are slight angular projections; from the side, the upper and lower margins are sinuous. Penis very long and slender and without the right-angled hook that is frequently found in *Hydroptila* species; beneath the penis is a broad lower penis-cover (termed by me in previous *Hydroptila* descriptions a " ventral plate ") with the apical margin produced at the centre in a slender finger. Inferior appendages large; from the side, with the upper margin sinuous and set with short broad teeth; it bears a black wart or rudimentary spur near the lateral margin towards the apex. From beneath, the margin of the eighth ventral segment is deeply excised. Ventral process very small.

Length of anterior wing, ♂, 3 mm.



Figs. 25–27.—*Hydroptila tasmanica* sp. n. ♂. 25 genitalia lateral, 26 dorsal, 27 ventral.

Tasmania: Wilmot, 9.i.17.

Type ♂ and paratype ♀ in Dr. R. J. Tillyard's collection.

A paratype ♂ (head missing) and a paratype ♀ in the British Museum collection kindly presented by Dr. Tillyard.

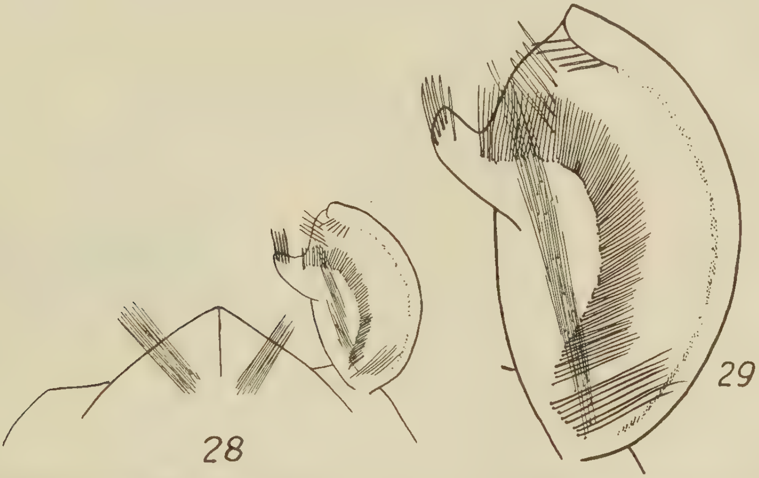
The shape of the wings of this species hardly conforms to the general pattern in the genus, so that it will be necessary to extend the generic characters to cover this extreme form. The structure of the genitalia and other characters, absence of ocelli, spurs, etc., show that it is correctly placed in *Hydroptila*, and it is possible that a reduced form of scent-organ is concealed beneath the scent-organ caps. Unfortunately it is not possible to make this out clearly in the single male head available.

AFRICA.

Hydroptila cruciata Ulmer. Figs. 28–29.

1912, Ergebn. Zentr. Afrika Exp., 1907–8, **4** (6) : 83, fig. 4.

As the scent-organ was not described when an account of the species was originally given, I supply the omission from a single male taken at Darfur.



FIGS. 28–29.—*Hydroptila cruciata* Ulm. ♂. 28 scent-organ (one scent-organ cap removed), 29 scent-organ cap (more enlarged).

The organ consists of an elaborate membranous lining to the scent-organ caps. This lining is set with elongate specialised scent-scales and can be produced in a short blunt filament, also carrying scent-scales, towards the apex of the cap. Supplementing this mechanism is a bunch of scent-hairs situated on the head at the base of each cap as in the European species *forcipata, maclachlani*, etc.

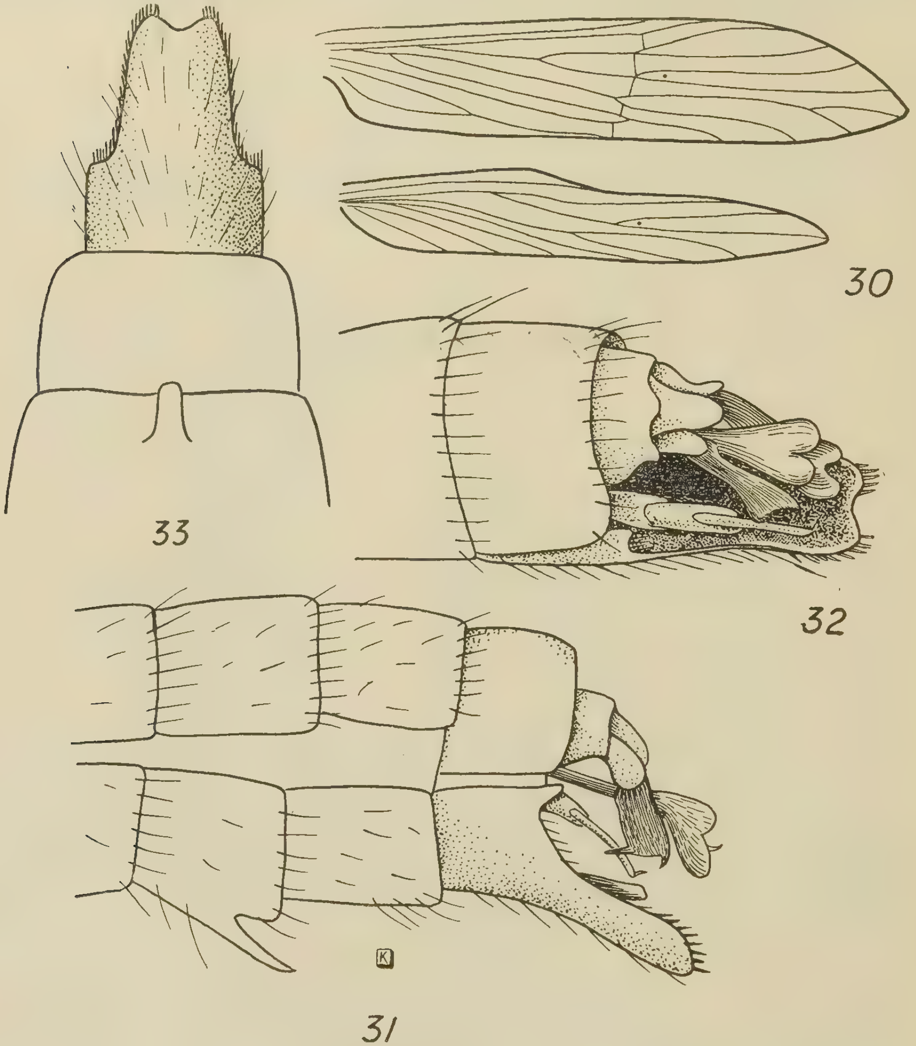
NORTH AMERICA.

Protoptila tenebrosa Walker. Figs. 30–35.

Walker.—*Hydroptila tenebrosa*, 1852, Cat. Neur. Brit. Mus., p. 134.

The general appearance of this insect is that of a species of *Hydroptila*, but with a strongly angulated costal margin to the posterior wing and neuration which indicates that it belongs to the genus *Protoptila* Banks.

Genitalia, ♂. Terminal dorsal segment produced to a rounded membranous apex with a strong transverse and sinuous ridge about midway; from beneath the produced segment, proceeds a pair of processes, possibly two-jointed, which may be intermediate appendages or even penis-sheaths, basal joints (?) short, apices much expanded, terminal joints nearly rectangular, each with a large strong tooth arising from the lower apical angle directed downward and slightly inward and a much smaller tooth at the upper apical angle, directed downward. Penis greatly dilated at the apex which, from above, appears as a pair of broad excised plates with the apical angles rounded; from the side, the upper plate is shorter than the lower with a fine short upturned hook or spine projecting beyond the apex and directed slightly upward; stem of the penis rod-like and very slender. Inferior appendages two-jointed, basal joint long and pencil-shaped, apical joint long, narrow, sinuous and terminating in an upturned hook. There is a very strongly chitinised lower penis-cover, consisting apparently of two long narrow plates side by side and possibly welded together; terminal ventral segment enormously produced to make a long tapering trough, margins heavily fringed, apex excised and with sharp upwardly directed angles



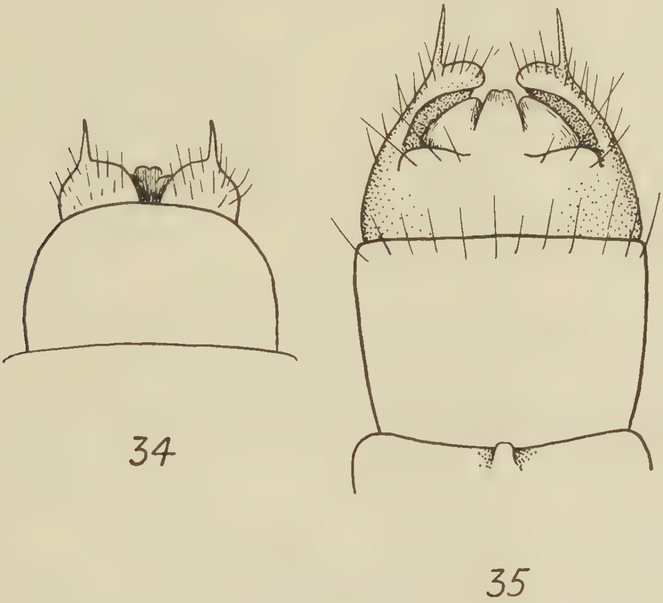
Figs. 30–33.—*Protoptila tenebrosa* Walker ♂. 30 wings, 31 genitalia lateral, 32 obliquely dorsal, 33 ventral.

fringed with strong hairs on the upper margin, towards the base. Ventral process strong and acute seen from the side, apex rounded from beneath.

♀. Terminal dorsal segment rounded; below and beyond it are seen two rounded lobes with their apical margins abruptly produced in very acute narrow processes; from beneath, the lobes arise from the lateral margins of the segment; they are narrow at their bases with dilated apices inclining towards each other, the narrow acute processes arising towards the lateral margins. Between these lobes is a trilobed process of which the central lobe is the broadest. A short blunt process to the anti-penultimate segment.

Length of anterior wing, ♂, 3 mm.; ♀, 3·5 mm.

Canada: St. Martins Falls, Albany River, Hudson Bay. Presented by G. Barnston, Esq.



Figs. 34–35.—*Protoptila tenebrosa* Walker ♀. 34 genitalia dorsal, 35 ventral.

Type ♂, 2 paratypes ♂, one paratype ♀ and one example without the abdomen in the collection of the British Museum.

Protoptila lloydi sp. n. Fig. 36.

The insect has been mounted in balsam to show the very characteristic side view. I am therefore unable to give descriptions of the dorsal and ventral aspects.

Genitalia, ♂. From the side; there is no membranous extension of the terminal dorsal segment as in *tenebrosa*; the intermediate appendages or penis-sheaths appear each two-jointed, basal joint almost entirely withdrawn into the segment, terminal joint dilated at the centre, narrowing towards the apex which is produced in a nearly parallel-sided extension with a downwardly directed truncate apex; penis arching slightly downward with a narrow neck and a much dilated rectangular apex. Inferior appendages two-jointed, basal joint sleeve-like, terminal joint, which can evidently be withdrawn into the basal, terminating in a nearly right-angled foot with a backwardly directed pointed toe.

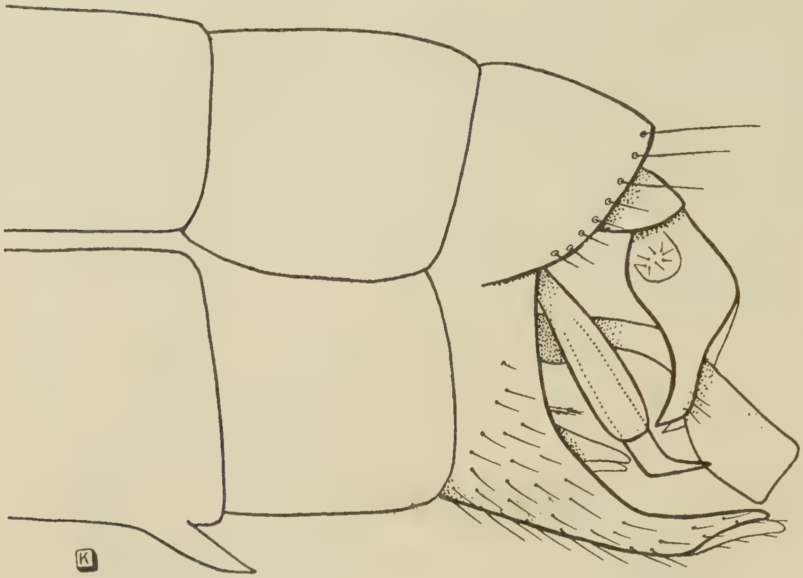


FIG. 36.—*Protoptila lloydi* sp. n. ♂. Genitalia lateral, very slightly from behind.

The lower penis-cover, which is strongly chitinised, consists of two plates broad at the base and narrowing towards the apices; above these plates is a pair of narrow fringed processes lying above the penis-cover. Terminal ventral segment very much produced as

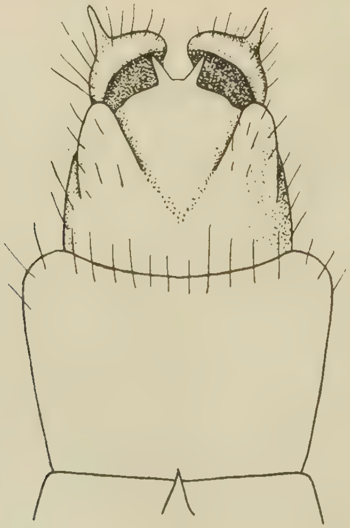


FIG. 37.—*Protoptila maculata* Hagen ♀. Genitalia ventral.

in *tenebrosa*, apex deeply excised, broad at the base, narrowing to the outwardly directed apices. Ventral process short and pointed.

Length of anterior wing, ♂, 2·5 mm.

U.S.A.: Ithaca, N.Y., H. Y. lab. August.

Type ♂ is a balsam preparation in the British Museum collection.

I have pleasure in dedicating this species to Mr. J. T. Lloyd, who very kindly presented me with a quantity of American material in which this species was included.

Protoptila maculata Hagen. Fig. 37.

Hagen.—*Beraea maculata*, 1861, Syn. Neur. N. Amer., p. 296.
Banks.—*Protoptila maculata*, 1904, Proc. Ent. Soc. Wash., **6** : 215, figs.
Ulmer.—1906, Notes Leyden Mus., **28** : 99, fig.; 1907, Genera Insect., **60a** : 220, fig.

Ulmer in his description of the species in 1906, Notes Leyden Mus., **28**, states that the co-type in the British Museum collection is a ♂. Unfortunately it proves to be a ♀, but the genitalia differs somewhat from that of Walker's *P. tenebrosa* and I therefore figure it here.

Oxyethira michiganensis sp. n. Figs. 38–40.

The specimens were received from Mr. J. T. Lloyd in alcohol and subsequently mounted in balsam. I am unable therefore to say anything about the general appearance.

Genitalia, ♂. From above, the margin of the eighth (?) dorsal segment is roundly excised and the lateral margins produced in long finger-like processes each carrying a long bristle at its apex; from the side these processes appear to arise from slightly within the segment and are broad at their bases with sharp angular projections on the upper and lower basal margins, then they narrow abruptly to slender upcurving terminations. Beyond what I believe to be the eighth segment, there appears a ninth, or perhaps it may be a false segment which, from above, is widely and shallowly excised: from the side, obtusely triangular; beyond the margin of this segment towards the centre, project two strongly chitinised down-curving stout hooks between which is the long penis with a dilated falcate apex; on each side of the stout central hooks are pairs of long finger-like processes which arise from a broad common base and are set close together and almost on the same level so that, from the sides, only one process of each pair is visible: each terminates in a single bristle and the apices of the inner processes are directed slightly inwards. There is a very broad ventral plate with a rounded and heavily fringed apical margin the centre of which is produced in a small process: the paired processes arise from the upper margin of this plate. Ventral process short.

Length of anterior wing, ♂, 3 mm.

U.S.A.: Michigan, 13.vii.1916.

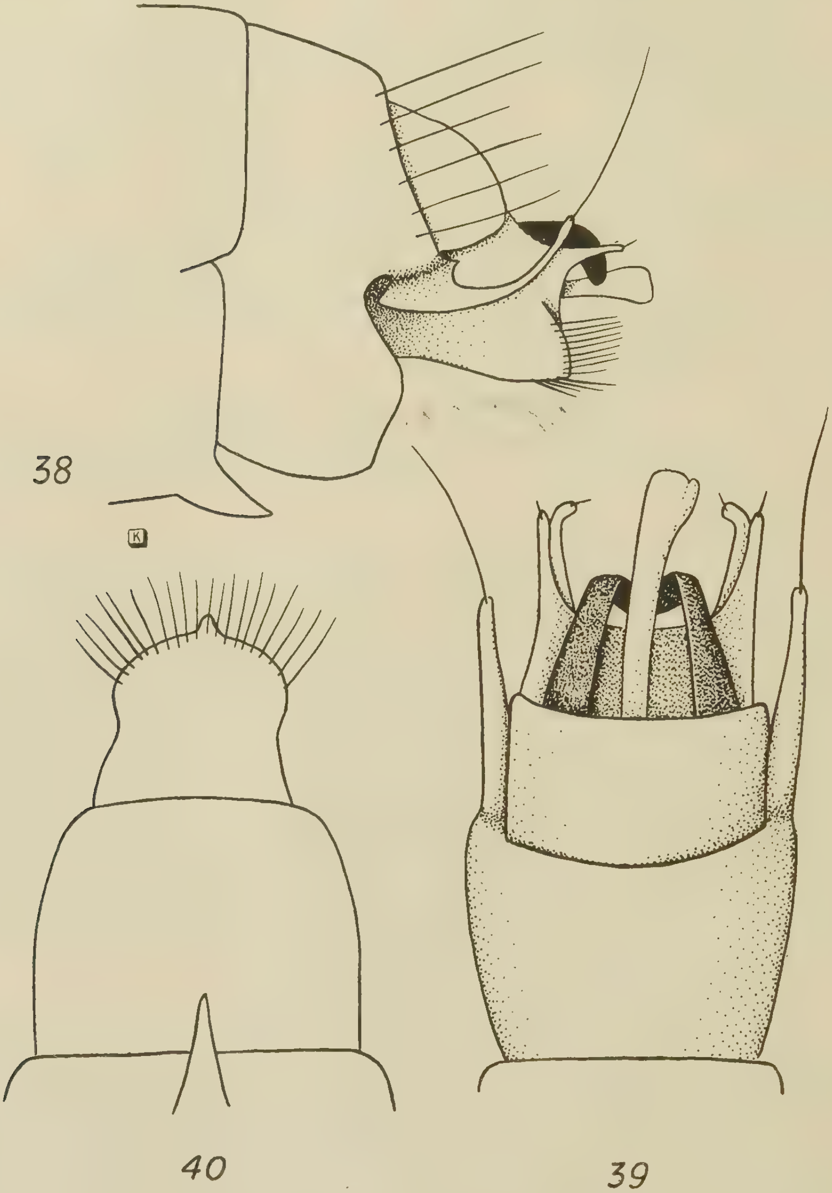
Type ♂ in the British Museum collection; paratype ♂ in the author's collection, both mounted in balsam.

The material was not in very good condition having been taken in a trap-lantern and preserved for some years in alcohol before being mounted in balsam. For the purpose of this description, the type has been removed from balsam, but, as may be imagined, the parts of this minute insect are now very transparent and not easy to make out.

Oxyethira forcipata sp. n. Figs. 41–42.

The type is a balsam preparation and I am therefore unable to describe its colour and general appearance.

Genitalia, ♂. Terminal dorsal segment deeply excised; in the cavity, from above, can be seen a long slender penis with a much expanded membranous apex; beneath this are two strongly chitinised stout incurving hooks, on each side of which is a pair of lightly chitinised finger-like processes each furnished at its apex with a few bristles; from the side, the lower pair of these processes curves slightly downwards. From the same aspect there is a rounded process projecting beyond the margin of the ventral segment which

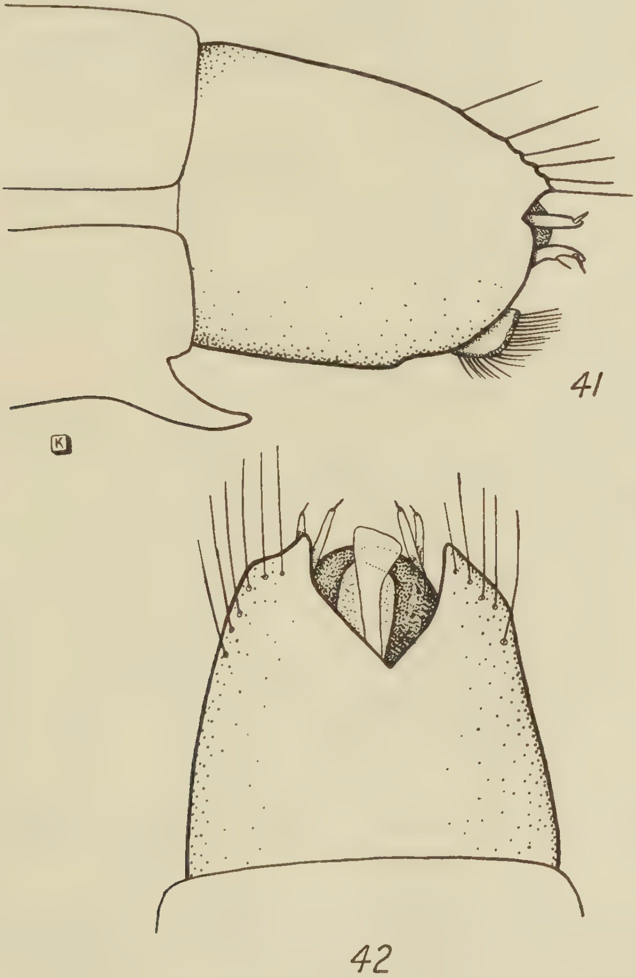


FIGS. 38–40.—*Oxyethira michiganensis* sp. n. ♂. 38 genitalia lateral, 39 dorsal (ventral plate omitted), 40 ventral.

may represent an inferior appendage, but I have not been able to distinguish it clearly in the single example before me. Ventral process short, stout and curved.

Length of anterior wing, ♂, 3 mm.

U.S.A. : Michigan, 13.vii.1912.



Figs. 41–42.—*Oxyethira forcipata* sp. n. ♂. 41 genitalia lateral, 42 dorsal.

Type ♂ is a balsam preparation in the British Museum collection. It was included in a comprehensive collection of Trichoptera in alcohol kindly presented to me by Mr. J. T. Lloyd.

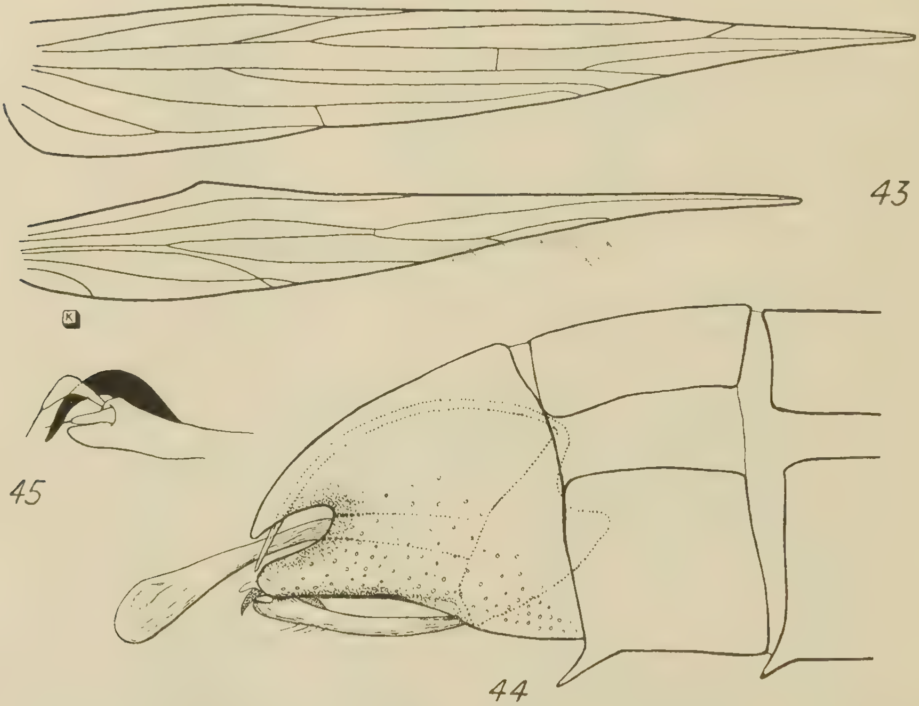
Central and South America, Jamaica.

Oxyethira bidentata sp. n. Figs. 43–45.

The type has been mounted as a balsam preparation, and I am accordingly unable to give a description of the general appearance of the insect.

Antennae 39 joints, basal joint rather large, next joint smaller than the basal but larger than the other joints. Ocelli present. Spurs 0, 3, 4.

Genitalia, ♂. Terminal dorsal segment strongly produced and from above obscuring all the genitalia. From the side, the tergite and sternite are welded in a broad plate with a deep excision at the apex to make a fork, the upper branch narrow, curving slightly downward, apex acute, the lower wider, directed tailward, apex rounded; the penis is seen in the excision projecting considerably beyond the apical margin, dilated at its apex; there are two long curved penis-sheaths of which only the apices are visible. There is a complicated lower penis-cover (?) consisting of a long ribbon-like plate curving slightly upward and dropping below the margin of the terminal segment, the apex armed with at least three processes one of which is a dark curved hook.



Figs. 43–45.—*Oxyethira bidentata* sp. n. ♂. 43 wings, 44 genitalia lateral, 45 apex of lower penis-cover (?) lateral.

As the preparation is mounted to show the lateral view, I am unable to give a description of the ventral aspect. There is a short ventral process on the penultimate and a still shorter process on the ante-penultimate segment.

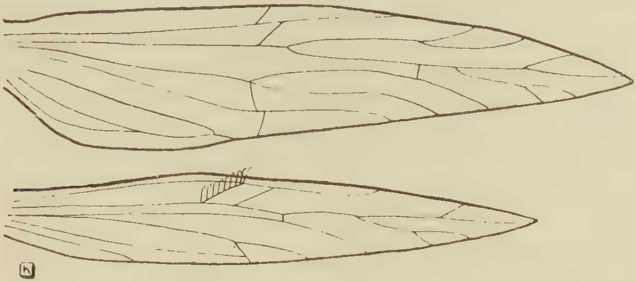
Argentina: L. Correntoso, 18–25.xi.1926; Terr. Rio Negro (*F. & M. Edwards*), Brit. Mus. 1927–63.

Type ♂ is a balsam preparation in the British Museum.

It is possible that this species may not be a true *Oxyethira*. Neither the neuration nor the genitalia conform entirely with the pattern of the European species. As, however, I have only a single example before me, I prefer to place it provisionally in *Oxyethira* rather than to erect a new genus for its reception.

Leucotrichia gen. n. Fig. 46.

Anterior wing rather broad towards the base, narrowing to an acute apex. Neuration tolerably complete but cross-veins very obscure. Posterior wing much more narrow than the anterior, also with an acute apex. There is a well-developed frenulum which, instead of lying along the margin of the wing, arises from what may be the subcosta and stretches downwards and basally to the next rather widely separated nervure. In the antennae, the joints are grouped in series some of which are white, others brown. Ocelli present. The palpi are difficult to make out in the preparation, but I believe the two basal joints to be short, the third to be very long, the fourth shorter than the third and the fifth as long as the third and fourth together. Spurs 1, 3, 4, very densely shrouded in hairs.



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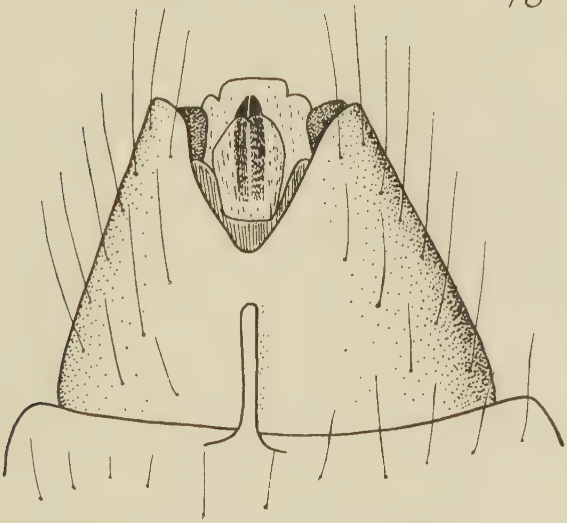

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FIGS. 46–47.—*Leucotrichia melleopicta* sp. n. ♂. 46 wings, 47 genitalia ventral.

Genotype, *Leucotrichia melleopicta* sp. n.

Leucotrichia melleopicta sp. n. Figs. 46–47.

Head brown with creamy-white hairs shrouding the face; ocelli present; antennae, at the base, seven joints creamy-white with a few widely separated brown hairs annulating the joints; the next four joints chocolate-brown with no annulation, the next two joints creamy-white, the next six brown, two terminal joints creamy-white, twenty-one joints in all. Palpi creamy-white clothed with sparse brown hairs. Thorax and vertex clothed with black hairs with two clusters of creamy-white hairs on each side. Legs pale brown, terminal tarsal joints creamy-white. Spurs 1, 3, 4. Wings: anterior broad, centre covered with a solid mass of creamy-white hairs, borders and fringes fuscous, the fuscous hairs slightly overlapping the central white hairs towards the apex. Abdomen: dorsal surface fuscous, sides clothed with short golden hairs.

Genitalia, ♂. Terminal dorsal segment produced to a somewhat flattened apex completely covering the genitalia. From beneath, terminal ventral segment deeply excised, the margins of the excisions heavily fringed; there are two dark rectangular processes appearing towards the inner apical margin of the excision; in the centre is a spade-shaped lower penis-cover above which can be seen the apices of two parallel and narrow plates, probably an upper penis-cover. There is a long slender process to the penultimate segment.

Length of anterior wing, ♂, 2 mm.

MEXICO: Teapa, Tabasco, March (*H. H. S.*).

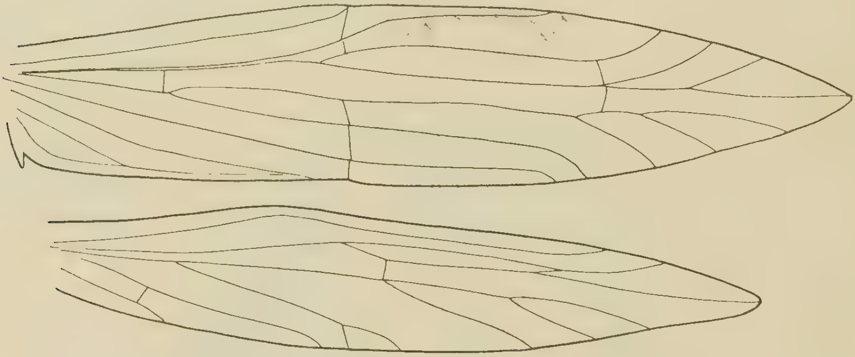


FIG. 48.—*Celaenotrichia edwardsi* sp. n. ♂. Wings.

Type ♂ in the British Museum collection is in balsam, the wings being mounted separately dry.

Celaenotrichia gen. n. Fig. 48.

This genus has been erected to take a single Chilean *Hydroptilid* in which the neuration differs from that of all other described species. A figure of the wings is given from which it will be seen that the neuration is fairly complete.

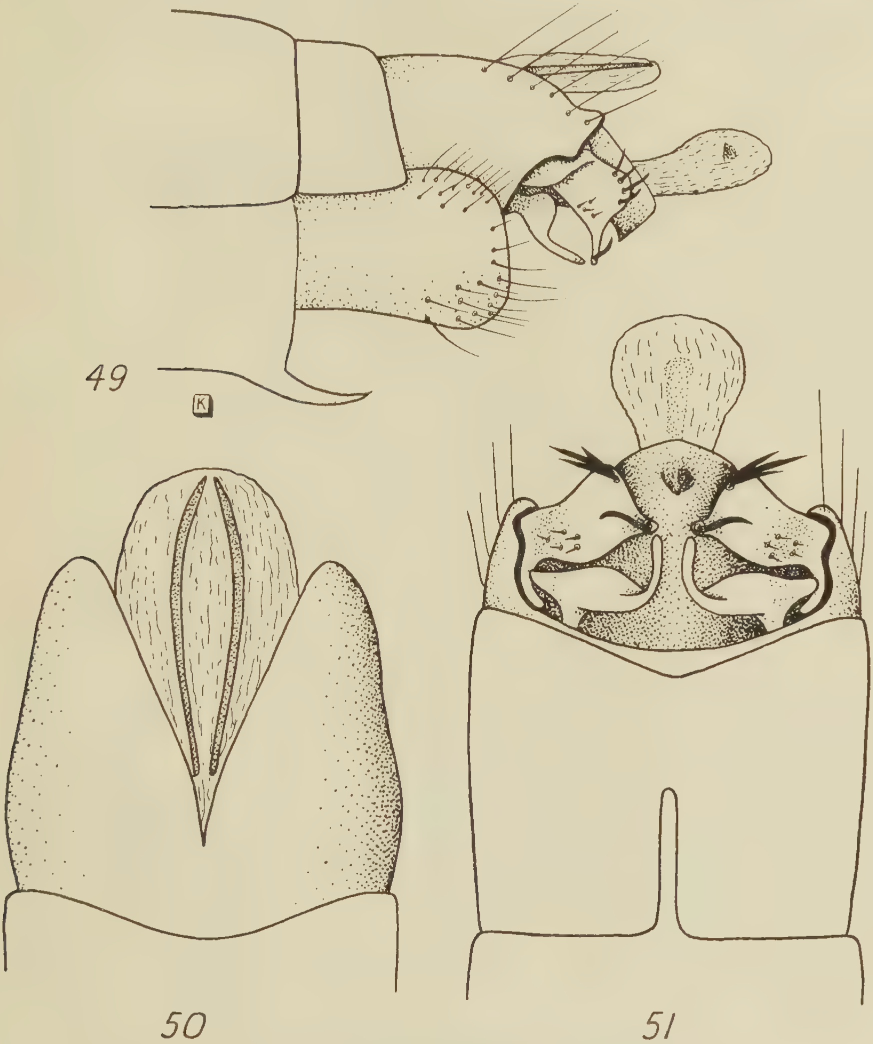
Antennae 26-jointed, the basal joint rather large and rounded, the next smaller and rounded, remaining joints each longer than the second. Ocelli present; maxillary palpi with the two basal joints short, third joint longer than the second, fourth of about the same length as the third, fifth the longest; spurs 1, 3, 4. Ventral process to the anti-penultimate segment.

Genotype, *Celaenotrichia edwardsi* sp. n.

Celaenotrichia edwardsi sp. n. Figs. 48–51.

Wings rather broad covered with dark chocolate-coloured pubescence, a small patch of white hairs on the costal margin towards the apex and two more small patches on the posterior margin, one nearly opposite that on the costa but slightly nearer the apex, the other towards the centre of the margin; fringes dark fuscous. Other characters detailed in the generic description.

Genitalia, ♂. The margin of the terminal dorsal segment is cut away in a deep V-shaped excision in which can be seen a membranous process strengthened by two chitinous rods, divergent at their centres and nearly meeting both at the bases and apices; beneath this is a down-turned membranous plate, somewhat parallel-sided seen laterally, with a truncate apex of which the lower angle is strongly chitinised and produced in a blackened hook; at the sides of this plate is a pair of intermediate (?) appendages, very broad as seen from beneath and carrying at their apical margins a few very long black spines; as seen from the side, the lower apical angle is produced in a downwardly pointing finger which carries at its apex a single black sinuous spine. Penis much exserted



Figs. 49–51.—*Celaenotrichia edwardsi* sp. n. ♂. 49 genitalia lateral, 50 dorsal, 51 ventral.

in the type, fleshy with a dilated apex. Inferior appendages from beneath, have the appearance of a pair of beheaded swans facing each other; from the side broad at the base and produced in a slender finger, the upper margin angulated towards the centre. Ventral process strong and curved.

Length of anterior wing, ♂, 3 mm.

S. Chile : Chiloe Isl., Castro, 20–22.xi.1926 (*F. & M. Edwards*).

Type ♂ and one paratype ♂ and one ♀ in the British Museum collection.

Scotiotrichia gen. n. Fig. 52.

This genus has been erected mainly on the wide difference that exists between the neuration of its single species and that in existing genera. In *Scotiotrichia*, the neuration is rather more complete than is usual in the Hydroptilidae, but the presence and position of the cross-veins is very obscure. I therefore merely give the figures of the neuration as far as I have been able to make it out and make no attempt to annotate the details.

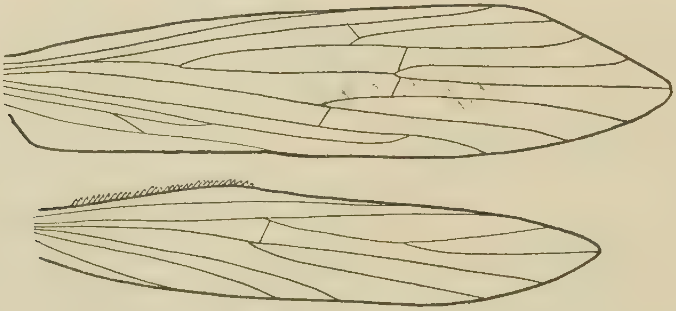


Fig. 52.—*Scotiotrichia ocreata* sp. n. ♂. Wings.

Head : antennae, basal joint stout, inner margin convex, outer nearly straight so that the joint is almost elbowed (the type is in a balsam mount and I give the appearance of this joint as seen in the preparation); second joint short, after the second the joints are rather longer. Maxillary palpi, first two joints short, third joint about as long as the two together, fourth joint slightly shorter than the third, fifth joint slightly longer than the third. Ocelli present.

Legs : spurs 0, 2, 3, the third spur of the posterior leg situated very close to the paired spurs.

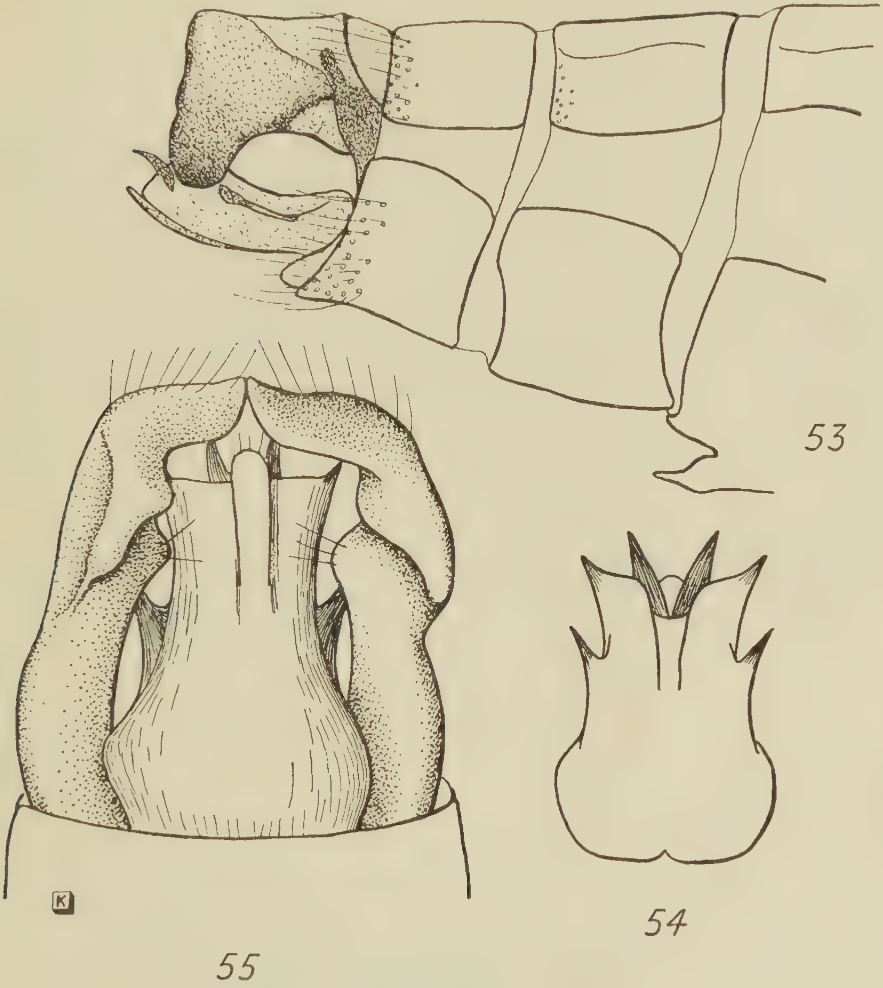
Genotype, *Scotiotrichia ocreata* sp. n.

Scotiotrichia ocreata sp. n. Figs. 52–55.

The general characters have been detailed under the generic description.

Wings rather broad, anterior with the apical margin obliquely truncate; both wings densely clothed with brownish-black hairs; anterior, with a very short yellow sloping streak about midway along the post-costa directed slightly upward and towards the apex.

Genitalia, ♂. From above, the terminal segment is produced in a large hood which completely covers the various parts. From the side, the apex of the hood is truncate, upper and apical margins straight and at right angles to each other; lower margin excised like the instep of the foot, lower apical angle rounded. From beneath, there is a process which may be a lower penis-cover, base wide and rounded, sides rather concave with acute projections extending from midway directed outward and towards the apex; apex truncate, each angle produced in an acute process. There is a central ridge projecting beyond the apical margin of the plate with a rounded apex. On each side of this ridge are seen two acute processes slightly divergent. From above, seen through the dorsal hood-like segment, the apical margin of the process is widely excised; in the centre of the excision can be seen the two divergent processes with a rounded lobe between them. From the side, the lower penis-cover (?) projects slightly beyond the dorsal hood curving very slightly upward. No other appendages are visible. There is a strong process to the antepenultimate segment.



Figs. 53–55.—*Scotiotrichia ocreata* sp. n. ♂. 53 genitalia lateral, 54 lower penis-cover (?) dorsal, 55 genitalia ventral.

Length of anterior wing, ♂, 4 mm.

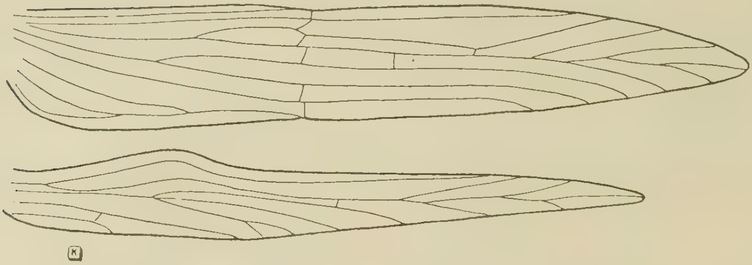
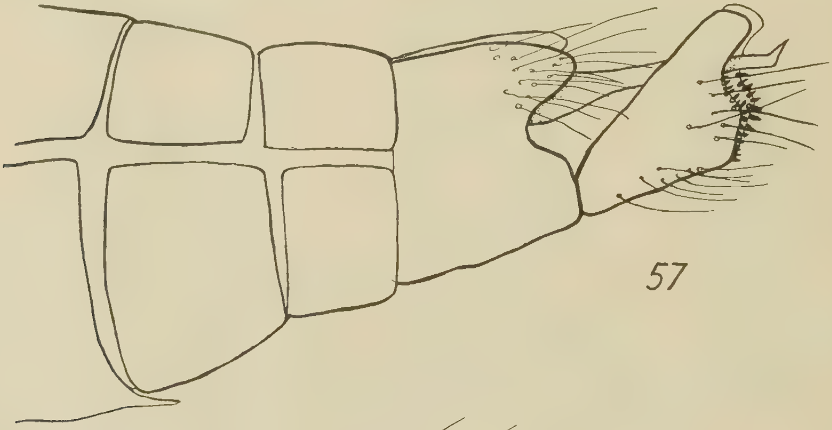


FIG. 56.—*Ochrotrichia insularis* sp. n. ♂. Wings.

Type ♂, ARGENTINA : Terr. Rio Negro, Bariloche, 3.xi–1.xii.1926 (*F. & M. Edwards*). Paratype ♂, S. CHILE : Llanquihwe Prov., Peulla, 12–13.xii.1926 (*F. & M. Edwards*) in the collection of the British Museum.

Ochrotrichia gen. n. Fig. 56.

This genus has been erected to take a single Jamaican species in which the neuration differs from that in all the other described genera. I will not attempt to give names to the forks and nervures but give a figure showing them as far as it is possible to make them out.



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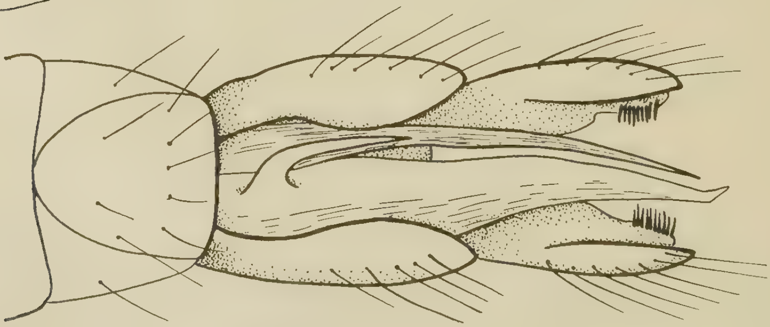

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FIGS. 57–58.—*Ochrotrichia insularis* sp. n. ♂. 57 genitalia lateral, 58 dorsal.

Head. There are two elevated lobes at the back of the head; antennae with 33 joints, basal joint long and rounded, second and third joints rather longer than each of the remaining joints, but shorter than the first; maxillary palpi, two basal joints short, third and fourth joints of about the same length, fifth joint longer than the fourth. Ocelli present, spurs 0, 3, 4. Ventral process short and pointed.

Genotype, *Ochrotrichia insularis* sp. n.

Ochrotrichia insularis sp. n. Figs. 56–58.

Wings light fulvous with whitish hairs, fringes light yellowish; neuration fairly complete; other general characters indicated in the generic description.

Genitalia, ♂. The apical margin of the terminal dorsal segment deeply and widely excised. From above, there can be seen lying in the excision and produced considerably beyond it, a pair of long spines, broad and apparently united at the base. In the preparation these spines appear asymmetric and the right spine, broader than the left, carries at its base a strong posteriorly directed hook. It is possible that the appearance of asymmetry may be due to the position in which the genitalia are lying in the preparation. From the side, the apex of the broader spine is directed upwards; the terminal segment from the side is deeply excised at its apex, the upper angle rather pointed, the lower broadly truncate; from these lower angles arise a pair of stout triangular processes each attached to the segment at one of the basal angles of the process, outer margin sinuous and closely set with strong black teeth which from above are directed inwards; from above, the upper margins of these processes are folded inwards. Penis not clearly distinguishable in the preparation. Ventral process short and pointed.

Length of anterior wing, ♂, 2·5 mm.

JAMAICA: Runnaway Bay, 14.ii.1905 (*Walsingham*).

Type ♂ is a balsam preparation in the British Museum collection with the wings mounted dry, paratype ♀, presented to the author some years ago by Mr. K. J. Morton.

SPIRAL AND OTHER ANOMALOUS FORMS OF SEGMENTATION WITH AN ACCOUNT OF THREE VENTRAL SPIRALS IN ONE BROOD OF *HADENA DISSIMILIS* KN.

By E. A. Cockayne, D.M., F.R.C.P.

[Read 4th April, 1934.]

With Plates III–V.

In 1929 I published a paper on spiral segmentation in insects giving descriptions of examples in Lepidoptera, Hymenoptera, and Diptera and referring briefly to those previously recorded, and in 1931 I described and figured another example in the larva of *Hipocrita jacobaeae* L. During the last two years I have found spiral segmentation in the larvae of two more species of Lepidoptera, *Lygris pyraliata* F., the first example in the Geometridae, and *Hadena dissimilis* Kn., and have received examples in two other species, a living larva of *Moma orion* Esp., sent by Mr. H. W. Head and a blown larva of *Hoporina croceago* F. kindly given to me by Mr. P. Bainbrigge Fletcher. Mr. C. J. Wainwright has given me two additional examples in Diptera, *Syrphus punctulatus* Verr., and *Pipizella virens* F., and Mr. O. W. Richards has given me a Hymenopteron, *Vespa silvestris* Scop., with spiral segmentation and I am much indebted to them for their kindness. Descriptions and figures of all of them are given below.

Since the publication of my first communication two very interesting papers on the same subject have appeared. Elmer T. Learned has given an account of a brood of *Apantesis nais* Dru. (Lepidoptera, Arctiidae) in which there were six larvae with incomplete dorsal spirals. From about 40 eggs laid by a moth taken at Green Village, N.J., imagines were bred, all the larvae being normal, and three pairings were obtained. From these pairings two of the broods, each consisting of about 100 to 150 larvae, were all normal, but in the third brood of about the same size there were six with spiral segmentation. Two of the abnormal larvae fed up quickly and produced pupae, one with a complete spiral and the other with the spiral incomplete anteriorly, and both the imagines showed the same formation. One of them, paired with a normal male of the same brood, laid eggs, but all the larvae were normal and no further generation could be obtained.

Mr. C. N. Hawkins has recently described a number of abnormal larvae of *Amathes* (*Orthosia*) *macilenta* Hübn. Two females were placed in the same bag, and, though one of them laid only a few eggs, it cannot be stated with certainty that all the abnormal larvae belonged to the same brood, and, even if they did, the exact ratio of normal to abnormal members of the brood cannot be given. Assuming that all the abnormal larvae were the offspring of one female the number of normal ones is probably a little too high. The eggs were torn from the muslin, on which they were laid while their development was proceeding, and Mr. Hawkins thinks that some may have been injured just as segmentation was beginning, and that the abnormalities may have been due to this cause. The majority of the larvae showed reduction in size or absence of a tergite or sternite or of half a somite, and only one had spiral segmentation. One larva had a double metathoracic leg and a projection, possibly an external wing-bud, on the same side of the metathorax.

The brood of *Hadena dissimilis* described and figured below contained three larvae with incomplete ventral spirals, three with reduction in the size of one half somite accompanied in two cases with the absence of a proleg, and one pupa with half a somite missing. There was also one larva with the dorsal line bifurcated, the area between the two forks forming a hump with four extra setae on it. The brood is particularly interesting because all three spirals are ventral. Most of the spirals recorded have been dorsal possibly because these are more noticeable. It is probable that absence or reduction in size of half a somite and spiral formation are due to the same cause. According to Morgan if, soon after the metameres have been formed, the dorsal and ventral portions of the mesodermal block of one side of one of these primitive half somites fails to grow as rapidly as those of the mesodermal block on the opposite side there will be a reduction in the size of one side of that somite at a later stage of development. If, however, the failure in growth is confined to the dorsal or to the ventral portion of a mesodermal block spiral segmentation may occur. Supposing that the failure is in the ventral portion of a block the normal ventral portion of the other side may come into contact and fuse with the ventral portion of the block of the somite immediately posterior to it. This is a satisfactory explanation of the beginning of a spiral, but does not account for its ending before the last somite is reached. In insects only one spiral is known which went to the last somite; all the others are short.

In my former paper I expressed a doubt as to whether there was any genetic basis for the majority of the abnormalities of segmentation in insects. Arendsen Hein's experiments with *Tenebrio molitor* L. prove that spiral and other abnormal forms of segmentation in this beetle are not inherited. " Abnormal abdomen " in *Drosophila*, though inherited, requires an additional environmental factor to make it manifest and appears to be a superficial defect, since it can be induced after the larva has hatched from the egg, and it is therefore not comparable with the abnormalities under discussion. The mutation " patched " in *Drosophila*, however, is an inherited defect apparently due to multiple factors and not affected by environment, and spirals, absence of half a somite, reduction in size of half a somite, and other abnormalities of segmentation are found.

The occurrence of spirals is rare, but not as rare as the published records suggest. In the last few years I have found examples in four species of Lepidoptera and Mr. C. N. Hawkins has found them in two others. These are distributed amongst more species and exceed in number the whole of those previously recorded. There is little doubt that many are overlooked, but, even if allowance is made for this, it is surely more than a mere coincidence that six spirals occurred in one brood of *Apantesis nais*, fourteen abnormalities including one spiral in one or possibly two broods of *Amathes macilenta*, and nine abnormalities including three spirals in one brood of *Hadena dissimilis*. I think that in these three cases at least there must have been a genetic basis for the defects, though in the case of *Amathes* there are good grounds for believing that injury may have been a contributory cause.

The parents of the abnormal brood of *Apantesis nais* were normal in the larval state, and the larvae bred from a spiral and a normal member of the brood were also normal, so that the condition is not due to a single dominant gene. The ratio of abnormal to normal is too low in all three cases for it to be due to a single recessive gene, unless it is sub-lethal—in *Apantesis* 6 : 100–150, in *Amathes* (assuming that all belonged to one brood) 14 : 116, in *Hadena*

9 : 79. There is no evidence as to the number of eggs of *Amathes* that failed to hatch, nor is there direct evidence about those of *Apantesis*, but in the latter species the brood was about the same size as the two normal ones, so that there are no grounds for believing that the death rate was unduly high. In the case of *Hadena* only two eggs were infertile, and of the fertile eggs only those laid underneath the others failed to hatch. After hatching very few larvae died; the number of deaths was no greater than is usual with any fairly large brood of Noctuid larvae. It is therefore very unlikely that the abnormality in *Hadena* is due to a sub-lethal recessive gene and still more unlikely that it is due to a dominant one. If the condition is inherited, as I believe to be the case, either more than one gene is involved or there must be an environmental factor as well as the genetic one. With regard to the other spirals described below nothing is known about the rest of the brood with the exception of the *Hoporina croceago* F., and it was the only abnormal larva out of about thirty bred from the same batch of eggs.

The evidence as to the underlying cause of abnormal segmentation is conflicting. Cappe de Baillon has described anomalies of segmentation including spirals in double monsters of the Phasmid, *Carausius morosus* Brün., most of which come from malformed eggs especially from those with two micropyles. He thinks the irregular segmentation is secondary and due to increased pressure inside the unyielding eggshell. In any case the condition is not inherited. He says, " Le nombre des œufs mal conformés est absolument indépendant de toute influence héréditaire. Toutes les femelles de *Carausius morosus* sont susceptibles de fournir des œufs mal conformés." Later he says, " En resumé, la production des œufs composés est un phénomène naturel, commun à tous les *Carausius morosus.* Elle est la conséquence du ralentissement de l'activité ovarienne provoqué par l'age; l'abaissement de la température, en ralentissant la nutrition, la parthénogénèse, en diminuant l'activité de l'ovaire, favorisent la production des œufs composés." It is improbable that the cause of abnormal segmentation in double monsters is the same as in otherwise normal insects, but the fact that it is not hereditary is interesting. Turning to the cases of anomalous segmentation, which are due to primary errors occurring at an early stage of embryonic life, we find that in *Drosophila* the mutation " patched " is undoubtedly an inherited defect, and that in three species of Lepidoptera, though definite proof is lacking, the condition is probably inherited, but in *Tenebrio molitor*, on the other hand, it is not inherited. Only careful breeding experiments will show which cases are due to an environmental cause and which are due to the action of a gene acting alone or in conjunction with some peculiarity of environment.

In company with Mr. H. Worsley Wood I took a female of *Hadena dissimilis* Kn. (*suasa* Bkh.) at Wicken Fen on the night of 10th July, 1932. A large batch of eggs was laid during the night of the 12th on the side of the tin, but unluckily those laid last were placed on the top of others laid earlier and many of the larvae were unable to escape. The eggs were left undisturbed and all except two proved to be fertile. Three or four larvae died during the first week, but the rest fed greedily on chenopodium and grew at a great rate and no more died. There were altogether 88 full-grown larvae. Mr. Wood had some and says that all his were normal, but amongst those sent to Mr. C. N. Hawkins five were abnormal and four of those I kept myself were abnormal, so that in all there were nine abnormal larvae out of 88. Of these three had spiral segmentation, two had a proleg missing, and a displacement of the lateral line, one had a reduction in the size of one side of a somite with displacement of the lateral line, and one had a prominence on the mesothorax with a bifurcation of the central line and extra setae. The following is a detailed description of the abnormal larvae.

(1) A spiral begins on the ventral aspect of the left side of the second abdominal somite and ends on the right side of the third abdominal somite. It appears to be incomplete at both ends, but if one may judge by Learned's larva of *Apantesis nais*, it might have been complete in the pupa. The first abdominal has all the setae in the usual positions, though in the figure they appear to be displaced owing to the larval rotation. On the half somite, the 2nd abdominal, that begins the spiral there are only four distinct setae instead of five; on the right half of the 2nd abdominal there are the usual five setae and on the left half of the 3rd, to which it is united, there is a proleg facing forwards and inwards and a normal setal arrangement. The spiral has caused considerable rotation of the anterior part of the larva and great displacement upwards of the lateral line on the right side. (Pl. III, fig. ~~2~~. × 3.) 1

(2) A spiral begins on the ventral aspect of the right side of the metathorax and ends on the left side of the second abdominal somite. On the half somite forming the right side of the metathorax there is a leg, which projects far to the right, and the normal complement of setae; the left side of the metathorax bears a leg and the usual setae and is united with the right half of the first abdominal, which has the normal number of well-marked setae (4); the left side of the first abdominal is united to the right side of the second and there are the normal number of setae present, 4 on the left and 5 on the right, though they lie somewhat obliquely; the left half of the second abdominal, which terminates the spiral, also has the full number of distinct setae (5). The spiral appears to be complete at both ends. The dorsal surface is divided normally, but the anterior part of the larva is very much rotated and the yellow lateral line is very much displaced upwards on the left side of the last two somites participating in the spiral. In addition to the spiral segmentation the last two segments of the right prothoracic leg are much reduced in size. (Pl. III, fig. 2. × 3.)

(3) A spiral starts on the left side on the ventral aspect of the second abdominal somite and ends on the right side of the third, the right side of the second being united with the left side of the third. The setal arrangement on the right and left sides is correct for a second and third somite respectively, and the left side has a well-formed proleg. The spiral is complete. The spiracle and lateral line are much displaced towards the dorsum on the left side of the second abdominal somite, as are the setae, of which seven are present instead of six. The two lying close together just below the spiracle probably represent a duplication of the sub-spiracular seta. The larva died pupating, but by softening it for three weeks in 10 per cent. potassium hydroxide the details of the structure became clearly visible and even the pigmentation of the dorsal surface became apparent. (Pl. IV, figs. 4, 5.)

(4) The left half of the sixth abdominal somite is much reduced in size and the proleg is absent. The spiracle is divided into a smaller lower and a larger upper portion. The post-spiracular, the sub-spiracular, and the other setae lying below the spiracular line are absent. The larva is bent with a concavity on the left side and slightly humped at the sixth abdominal somite. (Pl. III, 5 fig. ~~4~~. × 3.)

(5) The sixth abdominal somite is much reduced in size on the left side, so that the larva is bent round with a concavity on the left and the dorsal surface is raised at this point. There is no proleg on the left side of this somite, and the spiracle, which is small and circular, is displaced towards the dorsum, and the

lateral line is sharply curved upwards and then downwards again. The subspiracular setae and all those normally found below the lateral line are absent. (Pl. III, fig. ~~3~~. × 3.) /4

(6) The right half of the second abdominal somite is reduced in size and the spiracle is small and circular and slightly displaced towards the dorsum. Behind the spiracle the lateral line runs upwards to the level of the subdorsal line, which is absent in the posterior two-thirds of the somite. The posterior trapezoidal seta is absent, and just below the lateral line are two setae, presumably the post- and sub-spiracular, the former displaced upwards and the latter downwards. (Pl. IV, fig. 6, dorsal view, × 4; fig. 7, lateral view, × 4.)

(7) The right half of the ninth abdominal somite of this male pupa is absent, but the defect was not noticed in the larva and was discovered when Mr. C. N. Hawkins examined all the pupae of the brood.

(8) The abnormality in this larva is one which I believe to be unique. At the posterior margin of the mesothorax the dorsal line bifurcates and the right-hand division first bends outwards and then, on the first two sub-segments, inwards and finally reaches the mid-line again at the posterior margin of the prothorax. This division is well defined throughout its length, and to the right of it are the usual four setae, which lie above the lateral line, somewhat crowded together but in the normal relation to one another and to the subdorsal line. The left-hand division is well defined on the fifth and on the posterior part of the fourth sub-segments, where it runs at first at right angles to the posterior margin of the somite and then turns upwards and outwards. The fine reticulations of the pattern are denser and run inwards and upwards from this point to the anterior margin of the second sub-segment, where they join the dorsal line, and I think they indicate the remainder of the course of the left-hand division of the dorsal line. To the left of the right-hand division there are eight setae above the lateral line instead of four. The tubercle of the third counting from the middle is smaller than the others, oval, and placed further back (it is drawn too large relative to the others in the diagram). It points inwards and backwards instead of forwards and outwards. The outermost four setae are of the same size and bear the same relation to one another and to the subdorsal line as the four setae of the left side of a normal mesothorax. The innermost four, however, are placed on a low conical elevation on the apex of which the small oval tubercle of the third seta is situated, and they are separated from the outer four by the faint left-hand division of the dorsal line. The line dividing the fourth from the fifth sub-segment is irregular on the left side and the fourth sub-segment is incomplete on the right side. On the left side of the second sub-segment of the metathorax there is an extra seta.

The conical elevation first drew my attention to the larva, and thinking it was an example of spiral segmentation I preserved it. I was in Scotland at the time, but had I been able to examine it with a microscope I should have detected the setal abnormality, made a diagram, and tried to breed the moth. It would have been interesting to have seen whether in the imago an extra wing arose from the site of the conical elevation.

I think the conical elevation with its four setae probably represents an extra half somite and that the left half of the mesothorax is double. But for the other anomalies of segmentation found in the same brood I should have little hesitation in regarding it as an incomplete double monster such as Cappe de Baillon has described in Phasmids. To bring it into line with the other segmental anomalies I suggest that there may have been a division of the primitive mesodermal block into two parts, each of which has formed a small but nearly perfect tergite on the left side. All the other defects in other members of the brood are, however, due to reduction in size of half of a single mesodermal block of a sternite or of two contiguous ones, whereas the defect in this case has led to reduplication of half a mesodermal block and the corresponding epidermal structures of a tergite.

In the diagram the reticulations are omitted, excepting those of the dorsal and subdorsal lines, and the yellow dots are accentuated. (Plate III, fig. 5. × 8.)

Hoporina croceago F. Chiddingfold, 16.iv.1931 (*P. Bainbrigge Fletcher*).

This was the only abnormal larva out of about thirty bred from the egg. It has a ventral spiral with absence of half of one of the somites participating in the spiral and reduction in the size of half of another somite. The end of the spiral is the right half of the fourth abdominal somite, the proleg of which is small and, being displaced outwards, projects laterally. The sternite of the left half of the fourth abdominal is united with the right half of the third. Tracing the latter on to the dorsum it is found to end in the middle line and to form a hump of thickened chitin. The anterior and posterior trapezoidal setae of the right side are both present. The whole of the left half of this, the third abdominal somite, is missing, whereas it should have completed the spiral as a half sternite bearing the first proleg of the left side. The left half of the second abdominal somite is very small, and there is no clear line of demarcation between it and the fourth; it has no spiracle and no dorsal, lateral, or ventral setae. Thus there are two spiracles and a proleg absent on the left side of the larva, which is sharply bent where the first abdominal approaches the fourth. The left proleg of the fourth abdominal is small and displaced forwards, the anterior trapezoidal seta of the left side is missing and the posterior trapezoidal is situated too far inwards and backwards, and the spiracle of the same side is displaced upwards. (Pl. IV, figs. 1, 2, 3. × 5.)

Moma orion Esp. New Forest, 22.viii.1933 (*H. W. Head*).

The larva was found amongst a large number bred from different batches of ova. They were sleeved and many had already pupated and others had been sent away, so that other spirals may have been overlooked. Several larvae with aberrant pattern, but without any abnormality of segmentation, were found in the same sleeve; two had the large dorsal mark on the fourth abdominal half yellow and half red, one had a similar condition on the fifth, and another on both fourth and fifth abdominal somites.

The abnormal larva has a dorsal spiral beginning on the left side of the first abdominal and ending on the right side of the second abdominal somite, the right half of the first being united with the left half of the second. The spiral is incomplete at both ends. Since the first abdominal has a large oval pale yellow mark in which both trapezoidal tubercles are situated, the spiral causes a great distortion and asymmetry of the markings. All the verrucae, however, are present, as the figure shows. In addition to the spiral there is another abnormality of segmentation. The dorsal and ventral halves of the fifth abdominal somite are reduced in size on the left side, the verrucae of the anterior and posterior trapezoidals are very small, the former having only two and the latter three tubercles and setae, the supraspiracular tubercle, is small, the large tubercle above the proleg, 'basalis' of Schierbeck, is absent, and the proleg itself is short and displaced upwards. The dorsal pattern is asymmetrical and a black line runs down between this and the following somite. The sixth abdominal somite is also distorted and instead of having a large oval pale yellow mark on the dorsum, it has an asymmetrical pattern of red and black similar to that of the fourth and seventh. The supraspiracular verruca is small. The larva is sharply bent to the left at the junction of the fifth and sixth abdominal somites.

In the figure the yellow areas are plain and the red ones dotted to indicate the arrangement of the pattern and colour. (Pl. III, fig. 4. × 7.)

Lygris pyraliata F. Braemar, 29.vi.1931.

I found the larva in company with a number of normal ones on some small plants of *Galium verum* growing along a line of posts and rails near the Dee. The last five somites are all abnormal. The sixth is unusually short and has on the right side a defect of the cuticle, which is raised and wrinkled between the anterior and posterior trapezoidal setae (alpha and beta), and the setae themselves are closer together than those of the opposite side. A dorsal spiral, incomplete at both ends, begins on the right side of the seventh and ends on the left side of the eighth abdominal somite. The central line is irregular and distorted being extended laterally at the divisions between the somites which begin and end the spiral, an abnormality often associated with spiral segmentation. The anterior trapezoidal is missing on the left side of the seventh, and the posterior trapezoidal on the right side of the eighth is represented only by its tubercle. I can see no trace of the anterior trapezoidal on the right side of the ninth, and other setae are displaced. In the figure the dark green central line is heavily dotted, the white subdorsal lines are left plain, and the paler green ground-colour is lightly dotted. This appears to be the first record of a geometrid larva with spiral segmentation. (Pl. III, fig. 3. × 6.)

Syrphus punctulatus Verr. Female. Crowborough, 18.v.1932
(*C. J. Wainwright*).

A spiral is formed beginning with the right half of the second abdominal tergite, running across the second sternite, then obliquely across the left half of the second and the right half of the third tergite to end with the left half of the tergite of the third abdominal somite. The first part of the spiral is very incomplete, the division between the second and third tergites on the right side being horizontal rather than oblique and only extending about a third of the way across the dorsum. The arrangement of the pattern, however, shows that it is an example of spiral segmentation. The terminal part of the spiral is complete. The pattern of the fourth abdominal somite is slightly asymmetrical. (Pl. V, fig. 2. × 19.)

Pipizella virens F. Female. Studland, 6.viii.1932 (*C. J. Wainwright*).

The spiral is very like that in the *Syrphus* and involves the tergites of the same somites, but the division between the right halves of the tergites of the second and third abdominal somites reaches the middle line, and there is a shallow groove separating the second tergite into two parts. The terminal part of the spiral is not quite complete. (Pl. V, fig. 1. × 19.)

These two left-handed spirals may be compared with the right-handed one which implicates the same somites of the *Chrysotoxum elegans* Loew figured in my previous paper. (Pl. XV, fig. 1.)

Vespa silvestris Scop. Worker. Tresco, Scilly Islands, 16.vii.1927
(*O. W. Richards*).

The fourth and fifth abdominal somites (excluding the waist) form a complete right-handed spiral. The left half of the fourth somite is completely separated from the right half and the right half of the fifth from the left half. As usual in such cases only the tergites are affected. The pattern is slightly asymmetrical, but not more so than in many normal individuals. It may be compared with the Hymenoptera described in 1929, *Trans. Ent. Soc. Lond.*, **77** : 179–80, and figured on Plate XIV. (Pl. V, fig. 4. × 33.)

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EXPLANATION OF PLATES III–V.

PLATE III.

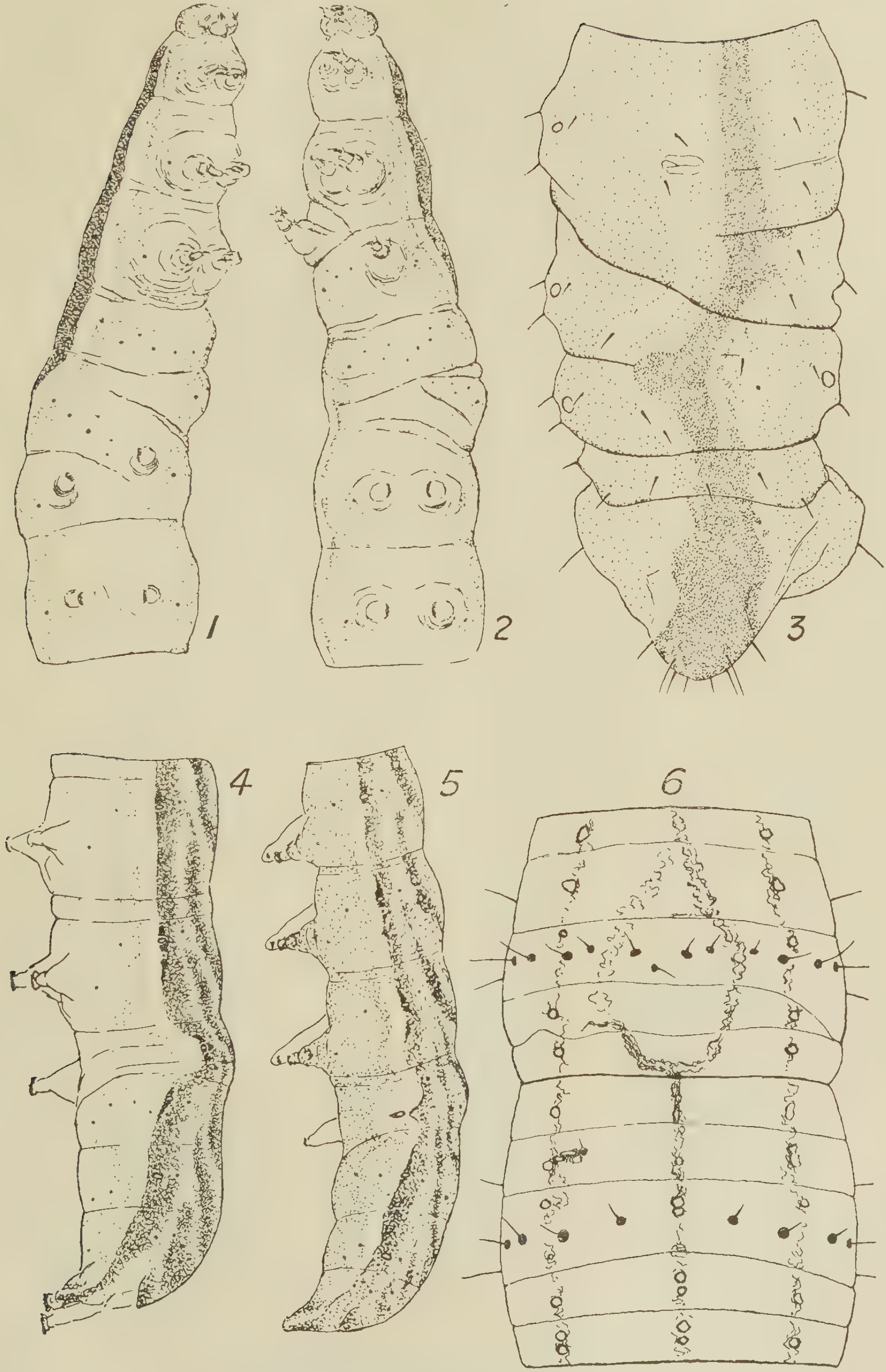
FIG. 1. *Hadena dissimilis* (no. 2). × 3.
2. *Hadena dissimilis* (no. 1). × 3.
3. *Lygris pyraliata.* × 6.
4. *Hadena dissimilis* (no. 4). × 3.
5. *Hadena dissimilis* (no. 5). × 3.
6. *Hadena dissimilis* (no. 8). × 8.

PLATE IV.

FIG. 1. *Hoporina croceago* (ventral view). × 5.
2. *Hoporina croceago* (lateral view). × 5.
3. *Hoporina croceago* (dorsal view). × 5.
4. *Hadena dissimilis* (no. 3), ventral view. × 8.
5. *Hadena dissimilis* (no. 3), lateral view. × 10.
6. *Hadena dissimilis* (no. 6), dorsal view. × 4.
7. *Hadena dissimilis* (no. 6), lateral view. × 4.

PLATE V.

FIG. 2 ~~1~~. *Pipizella virens.* × 19.
1 ~~2~~. *Syrphus punctulatus.* × 19.
4 ~~3~~. *Moma orion* (dorsal view). × 7.
3 ~~4~~. *Vespa silvestris.* × 33.



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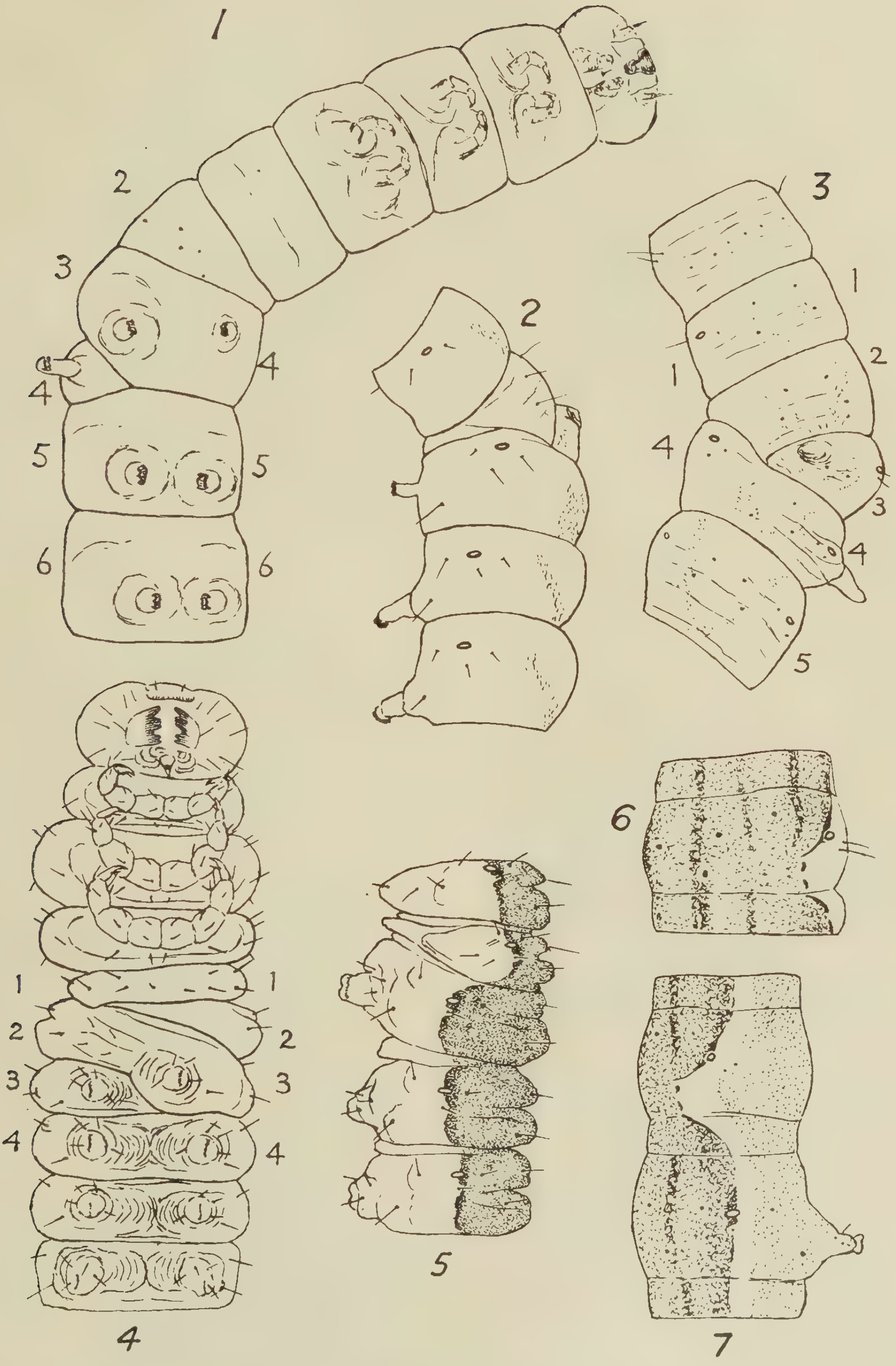
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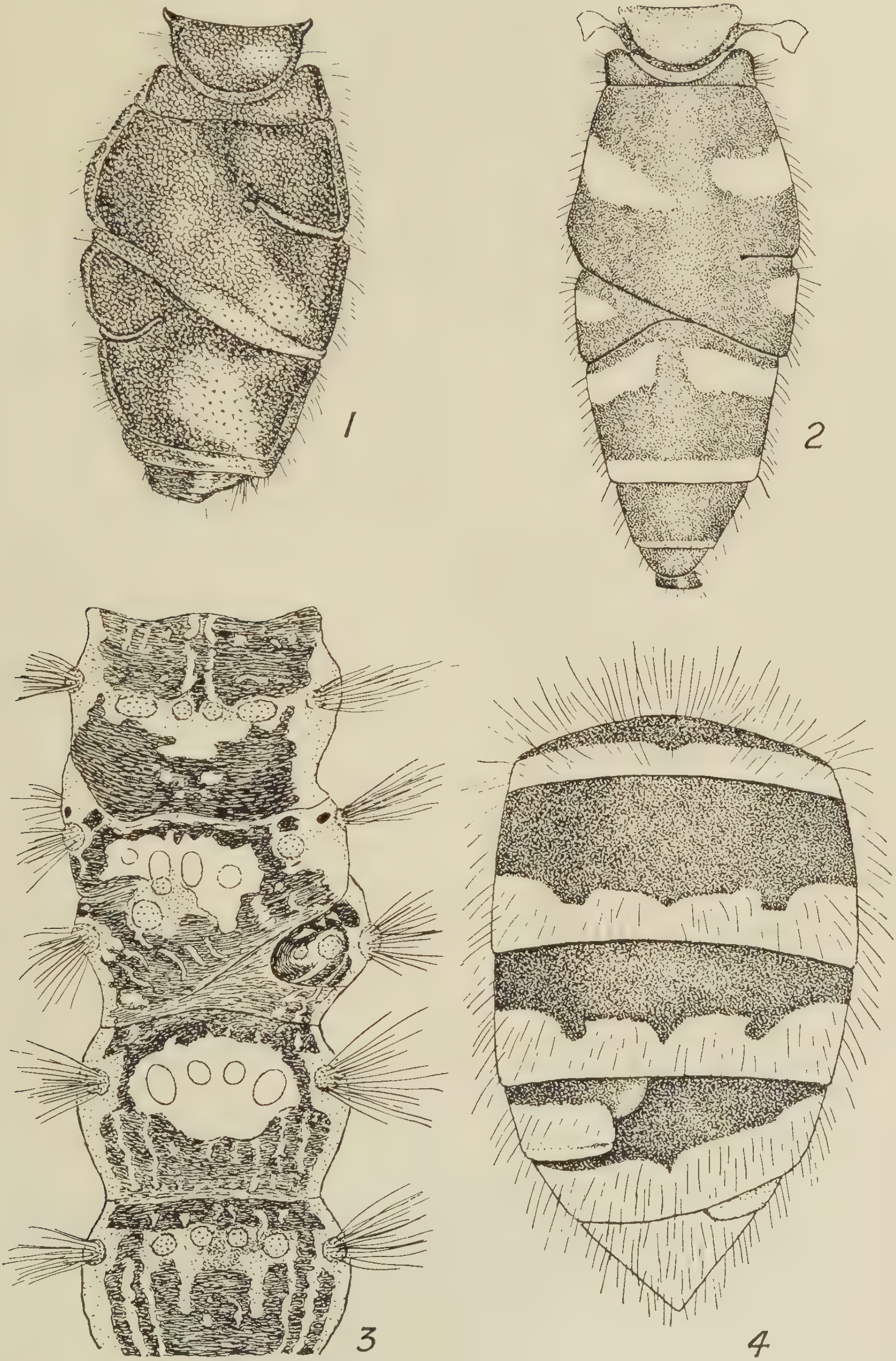

Spiral and other forms of Segmentation.

THE AMERICAN SPECIES OF THE GENUS *TRYPOXYLON* (HYMENOPT., SPHECOIDEA)

By O. W. Richards, M.A., D.Sc.

With Plates VI—X.

[Read 3rd October, 1934.]

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Introduction.

The following attempt to revise the American species of the genus *Trypoxylon* is the outcome of a visit paid to British Guiana in 1929, as a member of the Oxford University Expedition. Major R. W. G. Hingston, M.C., the leader, Mr. J. E. Duffield and myself were principally concerned with Entomology, and Expedition specimens mentioned in the text were obtained by one or other of the three. On returning to England, it was found impossible to determine our specimens of *Trypoxylon* from either the literature or collections available. In my endeavour to remedy this difficulty, I have been led into a somewhat larger work than is ordinarily entailed in the identification of thirty specimens. I think, however, it may be regarded as one of the "Results" of the Expedition although so largely based on borrowed material.

The genus *Trypoxylon* is a very large one, of world-wide distribution. Dalla Torre (1897) in his catalogue records 112 species, of which 76 were described from America, one name (*T. rostratum* Taschbg.) being correctly placed as a synonym. Since the issue of the catalogue 88 more species have been described, 39 from America, and one new variety has been described and one accorded specific rank. There are thus 115 species and one variety recorded from America. Of these I have seen the types of 48 species and more or less certainly identified specimens of 25 more. Of these 73 names, thirteen are regarded in the present paper as synonyms and one is accorded only varietal status, making 60 species and two varieties. Further 90 species and 10 varieties are described as new, making 150 species and 11 varieties. Of the 42 species known to me only from their descriptions, 19 are probably synonyms of species included in the present paper, while 23 are apparently distinct or are unrecognisable. In several instances it has been thought better to describe a species as new until this synonymy is established by examination of the types. There are thus probably about 170 known American species but undoubtedly many more await discovery.

MATERIAL STUDIED AND ACKNOWLEDGMENTS.

The basis of this work has been the collection of the British Museum, containing the numerous types of Smith and Cameron. Mr. R. B. Benson has been kind enough to place every facility at my disposal. Herr Dr. F. Maidl lent all the unidentified material in the Vienna Museum and also the types and paratypes of certain species preserved there. Herr Dr. H. Bischoff (Zoologisches Museum der Universität, Berlin), Miss Grace Sandhouse (through Dr. J. M. Aldrich and Dr. H. Morrison) (U.S. National Museum, Washington) lent all unidentified specimens available and also certain paratypes and identified specimens. Mons. L. Berland lent the specimens in the Museum national, Paris. Prof. Poulton lent specimens from the Wilson Saunders collection, Hope department, Oxford University Museum; Herr Dr. F. van Emden specimens from the Dresden Museum; Herr Dr. L. Brüel lent Taschenberg's types from the Halle Museum and Mons. J. Carl certain specimens from the Saussure collection at Geneva. Mr. J. D. Cleare, Jr., lent the specimens in the collection of the British Guiana Dept. Agriculture collection. Dr. G. Salt and Messrs. W. S. Bristowe, D. Elden Beck, A. M. Gwynne and D. Vesey FitzGerald allowed me to study specimens in their collections.

I am also indebted to Prof. Dr. S. Bengtsson for information as to types of Dahlbom at Lund, Herr Dr. K. L. Henriksen—types of Fabricius at Copenhagen and Herr Dr. O. Schröder—types of Fabricius at Kiel.

I wish to record my gratitude to all these kind helpers.

In the course of the present work about 1000 specimens of *Trypoxylon* were examined. In many species there was not nearly enough material to establish the limits of variation. In one or two species where ample material was available the difficulty of separation from allied forms was much increased, owing to the greater range of variation encountered. Some of the species known at present from only a few specimens may later prove to intergrade with others which seem to be quite distinct; I think, however, that most of them will retain at least varietal status.

In recording the data of specimens examined the following abbreviations of the names of Museums have been used :—B., Berlin; B.C.A., material described in the Biologia centrali-Americana, now preserved in London; B.G., Dept. Agriculture, British Guiana; D., Dresden; G., Geneva; H., Halle;

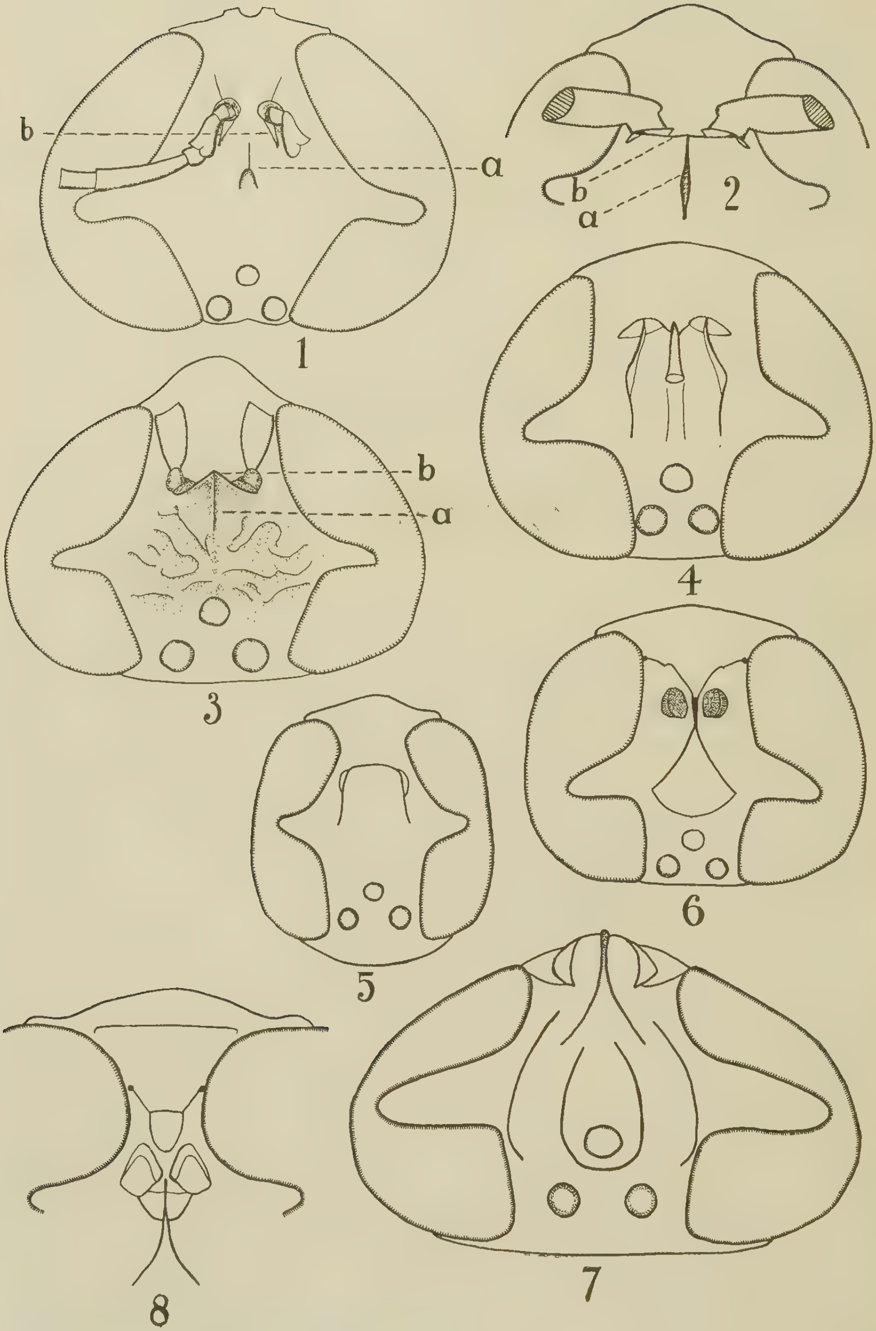
L., London (Natural History Museum); O., Oxford; P., Paris; V., Vienna; W., Washington.

GENERIC AND SPECIFIC CHARACTERS.

The head. The antennae are 12-segmented in the female, 13 in the male (in the male of *T. mandibulatum* Rich. 12-segmented). The first segment is distinctly constricted near its base to form a rounded articulating portion. In the female the specific differences are usually slight, though in a few species (*T. segregatum* sp. n., etc.) the third segment is scarcely twice as long as broad, instead of three or four times as is usual. In the male the thirteenth segment is often more or less elongate, sometimes (*T. albitarse* F., *T. clavicerum* Lep.) as long as the three or four preceding segments together. When the thirteenth segment is long it usually tapers to its apex and is sometimes slightly sinuate, while in some specimens a depression will be found on its outer (lateral) surface. These depressions are of no significance, since they are sometimes present on one side and absent on the other. In the males of certain species of the groups of *T. fabricator* Sm. and *T. marginatum* Cam. some of the antennal segments are thickened or are produced into angular processes on their ventral surface. In describing the proportions of antennal segments, the breadth is always taken at the mid point.

The antennae are articulated to the head by a socket which is defined by a thin rim, which is sometimes distinctly elevated. On their inner margin these sockets approach one another to a very varying degree; in some species they are almost contiguous (*T. frioense* sp. n., *T. frigidum* Sm.), while in most they are separated by a distance equal to the diameter of the socket. In the subgenus *Trypargilum*, the inner posterior part of the rim is usually produced into a slight keel running a short way towards the occiput. These keels define the inner limit of the antennal scrobes, or cavities into which the scape of the antennae can be retracted. These scrobes vary much in their development and are sometimes practically absent. Normally (figs. 1 and 4) the two keels are parallel and not very obvious (easily distinguishable in *T. cinereum* Cam.), and the surface of the head between them passes without a break from the vertex to the clypeus. This condition is never found in *Trypoxylon* s.s. In this group (fig. 3) one of three other conditions is found. Either the limiting keels are completely absent (*T. rugiceps* D.T., etc.), or they are replaced by a transverse keel immediately above the sockets. This transverse keel may be straight or strongly angulated, the angle projecting between the sockets. Where such a transverse keel is formed it marks the ventral limit of the vertex and the upper edge of the clypeus lies at a distinctly lower level. In most species a short little-raised keel is found on the mid line of the head, just above the ends of the limiting keels; this is the supraantennal keel. In *Trypargilum* (figs. 1 and 4) it usually becomes more elevated towards its posterior extremity, where it bifurcates to form a small horseshoe-shaped keel. Thus the whole structure to which the term supraantennal keel may be applied, can be described as a median prominence, slightly more raised behind than in front, bearing a fine median keel and truncated posteriorly; the truncate posterior face is defined on each side by the arms of the bifurcating keel and is usually smooth and shining in contrast with the surrounding sculptured areas. In *Trypoxylon* s.s. (fig. 3) the supraantennal keel, if present, is in the form of a simple keel only, sometimes borne on a longitudinal prominence.

In three groups (those of *T. marginatum* Cam., *T. scutatum* Chevr., and *T. rufidens* Cam.) the limiting and supraantennal keels are replaced by an



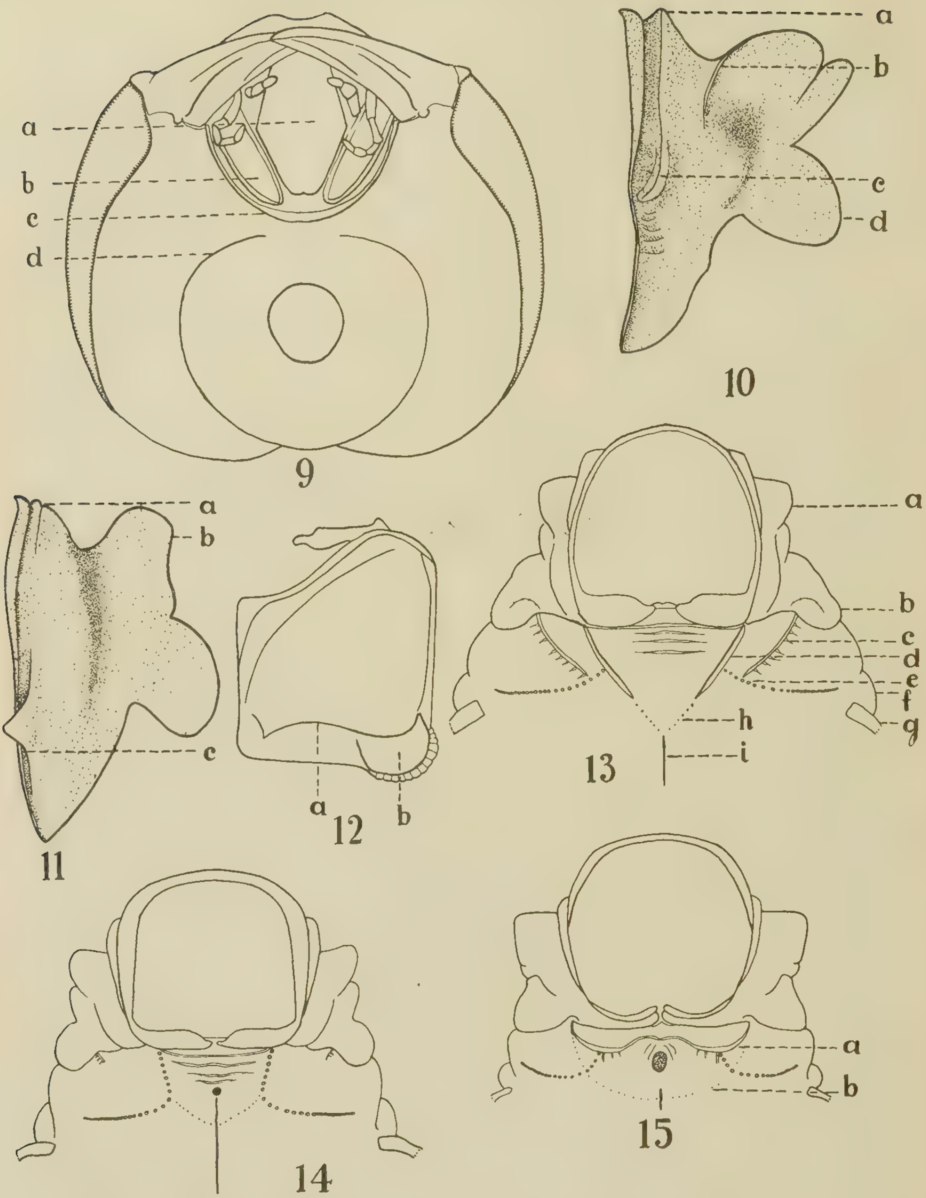
Figs. 1–8.—(1) Antero-dorsal view of the head of *T. nitidum* Sm., male. (*a*) Supraantennal keel. (*b*) Limiting keel of antennal scrobe. (2) Antero-dorsal view of the lower part of the head of *T. staudingeri* sp. n., female. (*a*) Supraantennal keel. (*b*) Limiting keels of the antennal scrobes, forming a straight, transverse keel. (3) Antero-dorsal view of the head of *T. fabricator* Sm., male. (*a*) Supraantennal keel. (*b*) Limiting keels of antennal scrobes, forming an angulated, transverse keel. (4) Antero-dorsal view of the head of *T. scrobiferum* sp. n., female. (5) The same of *T. rufidens* Cam., female. (6) The same of *T. marginatum* Cam., male. (7) A dorsal view of the head of *T. fiebrigi* sp. n., female. (8) An antero-dorsal view of the lower part of the head of *T. fiebrigi* sp. n., female.

entirely novel specialisation. The group of *T. rufidens* Cam. (fig. 5) shows the least modification. The lower edge of the vertex is defined by a distinct keel, bent in a horseshoe with its arms nearly parallel. Below this keel there is a sudden drop in level on to the clypeus and there is no supraantennal keel. In the group of *T. marginatum* Cam. (fig. 6) there is a distinct keel between the sockets of the antennae. This keel is in some species very short, while in others it bifurcates below and its arms reach down to the clypeus. In all species the keel bifurcates above the antennal sockets and the arms proceed towards the centre of the eye-emargination. In some species they die away here while in others (*T. punctivertex* sp. n., etc.) the central part of the vertex is depressed and a very strongly marked shield-shaped area is defined. In the group of *T. scutatum* Chevr. a very similar specialisation is found, but I believe this has been independently developed. There is a similar heart-shaped or oval area, but the median ocellus is included in it. From the point where the keels bend round, at the centre of the eye-emargination, a supplementary keel is emitted which penetrates the emargination. The keel between the antennal sockets is not, in this group, a single structure but becomes double just before it joins the main keels above the sockets. From the small depression defined by this double keel arise several strong white bristles which bend down and overhang the clypeus. The two groups differ in several important points in other parts of the body and are found in quite different geographical regions, the group of *T. marginatum* Cam. being entirely American and that of *T. scutatum* Chevr. occurring from S. Africa to Australia, with one aberrant member in Mexico. One American species, *T. fiebrigi* sp. n. (figs. 7 and 8), seems to be quite isolated. The keels on the vertex have a very peculiar arrangement (fig. 7), perhaps nearest to that found in the group of *T. marginatum* Cam., but in other respects it is closer to the group of *T. fabricator* Sm.

The sculpture of the vertex varies much amongst the species, being sometimes rugose, sometimes punctured with or without a network of fine lines (alutaceous) between the punctures, sometimes coriaceous. Very rarely (*T. fabricator* Sm. and its immediate allies) there is marked sexual dimorphism in sculpture. The two posterior ocelli are nearly always slightly larger than the median ocellus. In the descriptions of previous authors the distance apart of the two posterior ocelli has been used as a specific character, being compared with the diameter of the ocellus. A more useful character, however, is the magnitude of the shortest distance between a posterior ocellus and the eye. This may be expressed as a fraction of the ocellar diameter and provides a specific character of great value, usually fairly constant within the species and rarely sexually dimorphic. In fact the characters drawn from the structure of the limiting keels, the supraantennal keel, the vertex and the ocelli are particularly valuable because they enable one to associate together the sexes of species which may be markedly dimorphic in several of the more important remaining specific characters.

The area immediately behind the posterior ocelli is the dorsal part of the occiput. Posteriorly the occiput is defined by the occipital keel which, curving round on the underside of the head, surrounds the foramen and on each side almost meets the keels surrounding the cavity (buccal cavity) in which the mouth-parts lie.

The compound eyes are on the whole very uniform throughout the genus, being of the reniform shape usually typical rather of Vespids. A specific character of some value may be found by comparing the shortest distance separating the eyes on the clypeus with that separating them on the vertex.



Figs. 9–15.—(9) Ventral view of the head of *T. cinereum* Cam. (*a*) Mentum. (*b*) Stipes of maxillae. (*c*) Keel defining buccal cavity. (*d*) Incomplete occipital keel. (10) Pronotum of *T. nitidum* Sm., seen from the left side. (*a*) Anterior division. (*b*) Collar with keel. (*c*) Lateral tubercle. (*d*) Posterior lobe, commonly called "tubercle" by Hymenopterists. (11) Pronotum of *T. balteatum* Cam., seen from the left side. (*a*) Anterior division. (*b*) Collar. (*c*) Lateral tubercle. (12) Ventral view of left proepisternum of *T. cinereum* Cam., female. (*a*) Keel, ending inwardly in a tooth. (*b*) Rounded tubercle. (13) Ventral view of pro- and mesosternal region of *T. cinereum* Cam. (prosternum, episterna and fore coxae removed). (*a*) Pronotal collar. (*b*) Posterior lobe of pronotum. (*c*) Dorsal keel and furrow of prepectus. (*d*) Ventral keel of prepectus. (*e*) Prepectal furrow. (*f*) Tegula. (*g*) Base of costa of fore-wing. (*h*) Imaginary line marking the posterior boundary of depression for reception of fore coxae. (*i*) Mesosternal carina. (14) The same in *T. salti* sp. n. Dorsal and ventral prepectal keels are absent. (15) The same in *T. figulus* L. (*a*) Transverse mesosternal keel. (*b*) Imaginary line marking posterior boundary of depression for reception of fore coxae.

Usually the distance is about the same in both regions, but in some species in one or other region the eyes are distinctly approximated. In the male of *T. monstrificum* alone the eyes themselves are distinctly modified. Here the part of the eye below the emargination is strongly swollen and separated from the upper part by a distinct transverse depression.

The clypeus has a wide range of structure. In its simplest form (group of *T. marginatum* Cam.) it is nearly flat and its anterior margin is gently curved, with at most a slight median projection. The clypeus then projects but little beyond a tangent to the lower margin of the eyes. In other species (group of *T. nitidum* Sm., etc.) the anterior margin is more or less emarginate or toothed, the details often differing sexually. The greatest dimorphism is, however, found in certain species of the group of *T. albitarse* F. Here the clypeus is convex, almost longitudinally keeled, and considerably produced below the eyes in both sexes. In the male there is further a large central process projecting from near the apex; beyond the process there may be various teeth or emarginations.

The mandibles are nearly always curved, pointed, untoothed organs, but in the females of the groups of *T. rufidens* Cam. and *T. mandibulatum* Richards they are short, broad and bidentate. In a few of the other species of *Trypoxylon* s.s. there is a very small dorsal tooth, but this can only be seen if the mandibles are suitably extended. In the males of the group of *T. superbum* Sm., they are short and sickle-shaped, very strongly curved at the base.

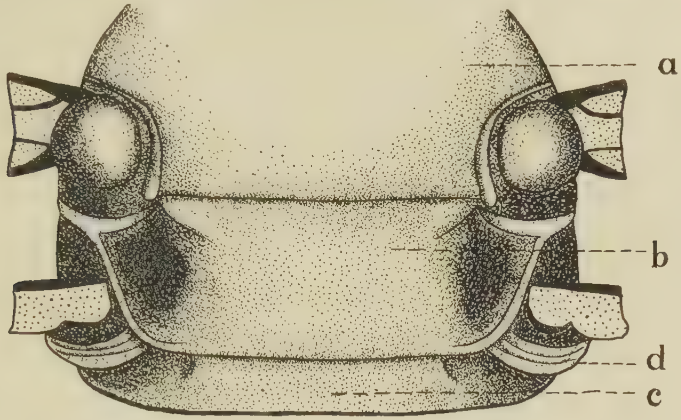
On the underside of the head the foramen occupies a position on the median line somewhat nearer the posterior than the anterior margin. Surrounding it but usually not quite completing the circle is the occipital keel. The two arms of this keel may, in a few species actually meet (occipital keel complete) or may run into the keel surrounding the buccal cavity (occipital keel meeting buccal cavity) or, as in most species, may end free (occipital keel incomplete). The buccal cavity, the depression for the reception of the mouth-parts, is defined by a raised keel, usually highest at its most posterior point. The head usually slopes evenly down from the occipital keel to the foramen except at a point on the mid line opposite to the highest point of the keel defining the buccal cavity; here there is usually a small area on the same level as the part of the head outside the occipital keel; this area is termed the "horizontal area behind the buccal cavity." It may be broad, narrow or absent, in which case the head slopes regularly down from the keel defining the buccal cavity to the foramen. This horizontal area is often crossed by a fine median longitudinal keel (gular suture). The part of the head outside of the occipital keel and lying between it and the compound eyes and the buccal cavity is termed the "tempora beneath"; its sculpture varies specifically.

The mouth-parts themselves have not been investigated in the course of the present work, except in so far as they are visible without dissection. The sculpture of the ventral surface of the mentum and of the stipes of the maxillae sometimes varies specifically. In some species of the group of *T. albitarse* F. the stipes bears ventrally and posteriorly a strong, pointed tubercle in the male and a smaller, rounded one in the female.

The thorax. The notum of the prothorax consists of an anterior and posterior region (collar) separated by a deep transverse depression, shallower only in the group of *T. rufidens* Cam. The anterior region is more or less adapted to fit under the occipital keel and bears laterally, just before the proepisternum, a more or less distinct "lateral tubercle" (figs. 10 and 11). This takes on various shapes. In the group of *T. marginatum* Cam. it is almost absent. In *T. fabricator* Sm. and its closest allies it forms a very strong triangular projection. In the subgenus *Trypargilum* it is usually represented by an elongate, sharp-edged elevation which sends a keel up towards the mid dorsal line. The posterior region of the pronotum fits closely on to the mesonotum and is produced postero-laterally into the pronotal tubercles which cover the anterior thoracic spiracles. Dorsally the posterior region is usually raised to form a sort of transverse, rounded collar, of which the centre, in a few species, is definitely angulated. The lateral angles of the collar are also prominent in some species (e.g. *T. cinereum* Cam., etc.). In some species of *Trypargilum* the angles of the collar are seen, in lateral view, to be bounded by a distinct keel (fig. 10*b*) (angles of pronotal collar bordered).

The prosternum, as in all higher Hymenoptera, is completely hidden beneath the episterna. The proepisternum in some species (group of *T. figulus* L., etc.) is quite simple in structure, but in many species there is a rounded prominence (the rounded tubercle, fig. 12*b*) near the postero-lateral corner; just anterior to this prominence is a transverse keel (fig. 12*a*). This keel may be nearly straight or strongly sinuate and may be produced into an angular tooth at one or both ends. The nature of the episternal keel, when present, provides one of the most important characters of a species. In the mesothorax, the notum and scutellum differ amongst the species mainly in sculpture. In a few species the scutellum is centrally impressed, usually it is flat but in some species (part of the group of *T. fabricator* Sm.) it is quite strongly convex. The mesopleura, apart from general surface sculpture, show very important specific characters in the arrangement of the sutures. The pleural suture (fig. 17*f*) which divides the mesepimeron from the mesepisternum is rarely well developed. The mesepimeron is always very narrow and the pleural suture is usually only developed ventrally as a small keel starting from the anterior margin of the keel defining the mid-coxal cavity and proceeding a variable distance up the pleuron, parallel to its posterior margin. The length of the pleural suture, expressed as a fraction of the length of the suture separating the meso- from the metapleuron, is an important character. A prepectus is developed in all species; it is defined by a strong furrow (fig. 13*e*; fig. 17*c*) starting just below the tegula and running into the mesosternum where it curves rather sharply forwards and runs out at the point where the pronotum ends ventrally. Another furrow (fig. 17*b*), also always present, runs horizontally from the top of the suture dividing the meso- from the metapleuron to the pronotal tubercle. This furrow, running just beneath the wing-bases, cuts off the top of the prepectus. Two other furrows (or keels) in connection with the prepectus are of major importance. The first (fig. 13*c*; fig. 17*a*) is the "dorsal furrow of the prepectus" which runs vertically downwards from the pronotal tubercle to meet the prepectal furrow near its lower end. The dorsal furrow is often defined below by a distinct keel and is sometimes rudimentary or only half crosses the prepectus. It is only found in the subgenus *Trypargilum*. In the same subgenus certain species (*T. fugax* F., etc.) have a strong ventral keel (fig. 13*d*) across the lower part of the prepectus. This is the "ventral longitudinal keel" which defines the lateral (dorsal) extension of the mesosternal hollow for the reception of the fore coxae. Though difficult to see, it appears to be a very constant specific character. In *Trypoxylon* s.s. the ventral longitudinal keel is never present but its place is taken by another keel (fig. 15*a*) which, starting near the ventral extremity of the prepectal suture, runs transversely across the mesosternum, under the fore coxae. In one or two species of *Trypoxylon* s.s. even this "transverse mesosternal keel" is not developed.

The mesosternum is always indistinguishably fused with the mesepisternum. The central part of the mesosternum is usually more or less depressed and bears a fine longitudinal keel (fig. 13*i*). Posteriorly, just in front of the mid coxae, the mesosternum is crossed by a furrow, which is often crenate. Behind this furrow it is produced into two lobes between the coxae. The details of structure here vary specifically but are difficult to describe. The most striking differences are seen in those species of the group of *T. albitarse* F. in which the male bears a hook on the first abdominal sternite. In these species the mid coxae are very widely separated and the lobes are very large and the ratio between their length and the distance separating their apices is specific.



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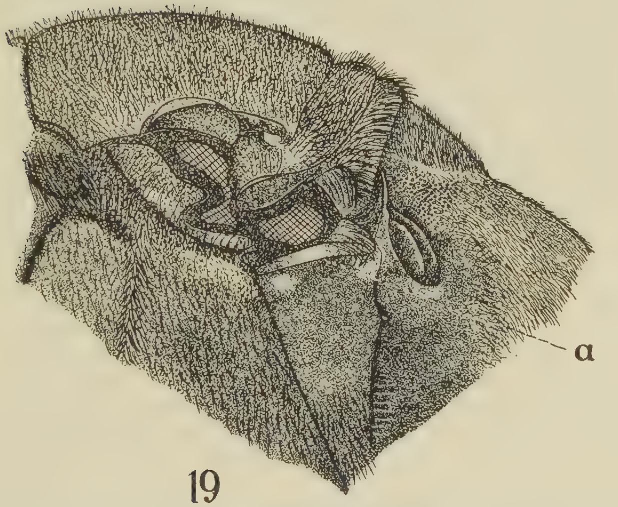

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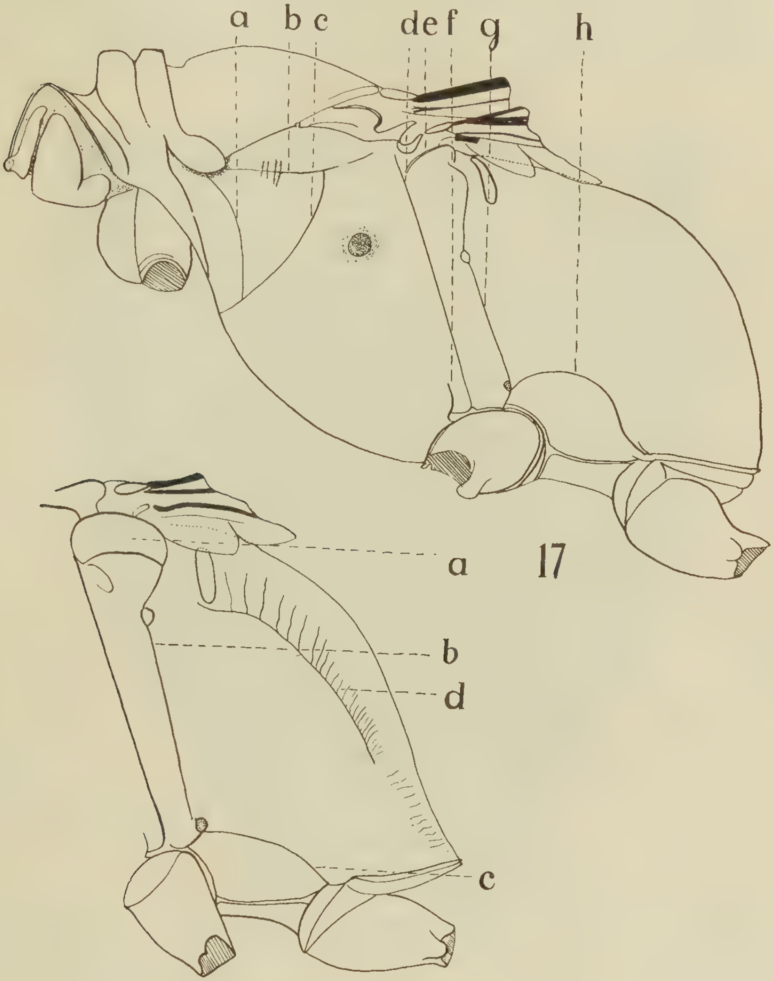
FIGS. 16, 19.—(16) Meso- and metanotum of a *Trypoxylon*. (*a*) Mesonotum. (*b*) Scutellum. (*c*) Disc of metanotum (postscutellum). (*d*) Lateral lobe of metanotum. (19) View from the left side of upper part of metapleuron and propodeum of *T. salti* sp. n., wings removed. (*a*) Lateral lobe of postnotum.

The metathorax, though much reduced in size, is taxonomically very important. The metanotum (fig. 16*c*) (postscutellum) may be flat or more or less bituberculated. On each side there is a depression, often more or less hidden by pubescence. Beyond this depression there is a flat, more or less crescentic area, only visible when the wings are well extended. This area (fig. 16*d*) may be smooth or crossed by small keels (striated). Its posterior margin in some species (*T. nitidum* Sm., etc.) is produced into a thin membranous expansion (fig. 17*e*; fig. 19*a*) overhanging the depression. I refer to this lateral area as the " lateral lobe of the metanotum." The metapostnotum (postnotum) is practically obliterated (by invagination) in its dorsal aspect, but it appears laterally, just beneath the base of the hind-wing, at the top of the metapleuron. Here it is more or less raised into a lobe or lamella whose development is of the greatest value in separating the species into groups. In the groups of *T. albitarse* F., *T. marginatum* Cam., *T. scutatum* Chevr., and *T. figulus* L., etc. the lateral lobe of the metapostnotum is little developed; it forms a slight, obtuse, horizontal keel, black in colour. In the group of *T. fabricator* Sm., however, this keel is extraordinarily high, forming a thin, flat, transparent lamella (fig. 18*a*). In the group of *T. nitidum* Sm. there is a moderately large lamella whose edge is bent downwards and only partly hyaline. Finally in the group of *T. spinosum* Cam. (fig. 19) the lamella is of enormous size and strongly deflexed, forming a large ear-shaped expansion. In a few species the lateral lobes are of a structure more or less intermediate between one or other of the four main types, but the exceptions are not numerous enough to invalidate the use of the character. The metapleuron shows no division into an episternum and epimeron, and is usually smooth and unsculptured. In its more dorsal part the metapleuron is separated posteriorly from the propodeum by a not very strongly marked suture. On the course of this suture are two small circular pits, the external evidence of invaginations. The upper of these is situated somewhat dorsally of the mid point of the metapleuron. The lower one lies just above the mid coxa. The furrow which joins these pits is much stronger in some species than in others and in some (group of *T. marginatum* Cam.) is crenate. From the lower pit there is a quite strong keel (fig. 17*h*) which separates the metapleuron from the propodeum and divides the metapleuron itself, separating the more dorsal part from the ventral part which comes into contact with the metasternum. This keel may be strongly curved or nearly or quite straight. This appears to be one of the best characters for the primary division of the species since in only a very few is there any difficulty in relegating them to one or other category. Posteriorly the keel is continuous with the raised ventral edge of the propodeum. Still more ventrally may be another fine keel, proceeding from the middle of the raised posterior margin of the mid-coxal cavity and running to the dorsal corner of the anterior margin of the posterior-coxal cavity. The upper of these keels (between the metapleuron and the propodeum) will be referred to as the " metapleural keel " and species in which the lower keel is developed will be described as having an " area defined." A narrow area, apparently also part of the metapleuron, separates the lower of these keels from the metasternum, which is itself bounded on all sides by more or less raised keels. The posterior margin of the metasternum is strongly raised between the hind coxae and the centre of this raised part is usually emarginate. The emargination may be either broad or narrow and in the former case either U-shaped or V-shaped. In the subgenus *Trypoxylon* s.s. the emargination is usually obliterated, the metasternum being merely produced into a point between the coxae.

The propodeum or median segment is often remarkably sculptured and almost every detail may be of taxonomic importance. Four surfaces may be distinguished, the dorsal, the posterior and the two lateral. In a number of species the dorsal area has no very remarkable sculpture, but in many the central part of the area is marked off by a U-shaped, often crenate, furrow. The area so defined is usually crossed by a central longitudinal furrow and its



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Figs. 17–18.—(17) View from the left side of the meso- and metapleuron and propodeum of *T. cinereum* Cam. (*a*) Dorsal keel of prepectus. (*b*) Transverse furrow cutting off top of prepectus and mesepisternum. (*c*) Prepectal furrow. (*d*) Mesopleural-metapleural suture. (*e*) Lateral lobe of the postnotum. (*f*) Pleural suture. (*g*) Metapleural-propodeal suture. (*h*) Metapleural keel, strongly curved. (18) View from the left side of metapleuron and propodeum of *T. rugifrons* Sm. (*a*) Lateral lobe of postnotum. (*b*) Metapleural-propodeal suture. (*c*) Metapleural keel, nearly straight. (*d*) Keel defining the sides of the propodeum above.

surface is often beautifully sculptured (fig. 20). The most frequent sculpture consists of a number of fine keels which anteriorly run diagonally outwards and backwards from the centre of the area, while posteriorly they are simply transverse. In a few species (*T. projectum* Fox, etc.) the posterior part of the dorsal area is raised into two tubercles. The posterior surface is always crossed by a median longitudinal furrow. Dorsally this furrow may gradually shallow out or end abruptly (" well-defined above "). Ventrally the furrow may end well before the reception of the abdomen or may continue more or less distinctly right up to that point. Often the bottom of the furrow is separated off from the upper part by a keel arising on each side of the reception of the abdomen. The area below this keel is termed the " keeled depression " (fig. 21*b*); its shape may be crescentic or more nearly quadrate. The structure of the orifice to which the abdomen articulates is of the greatest importance in separating the species-groups. In the subgenus *Trypargilum* the dorsal edge of the orifice is strongly flattened (fig. 21*c*), forming a quite broad surface;

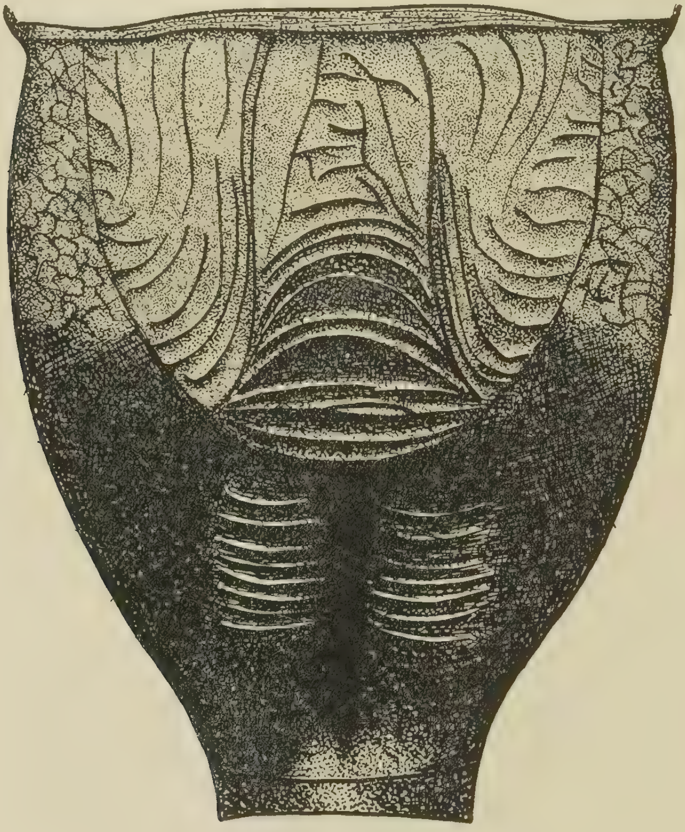

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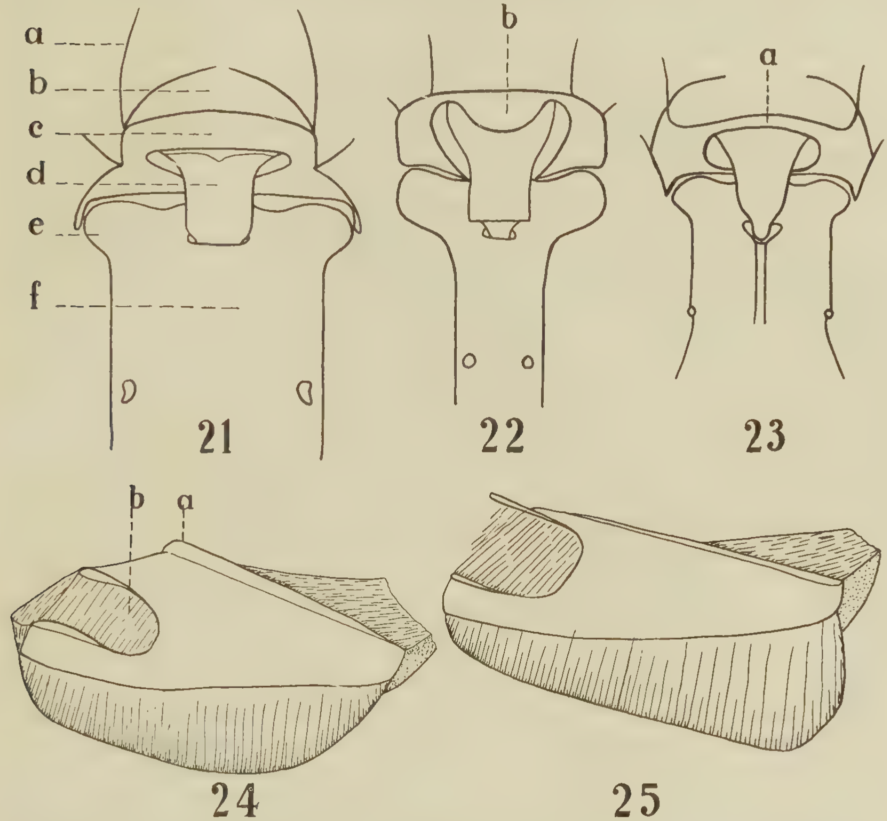
Fig. 20.—Postero-dorsal view of propodeum of *T. ecuadorium* sp. n., male. Showing dorsal area, with central depression and posterior furrow. The angles are regularly striate.

sometimes the flattened area is hollowed out ventrally, but is always easily recognisable. In all the remaining species the dorsal edge of the orifice is more or less lamelliform. In *T. fabricator* Sm. and its closest allies the edge (fig. 22*a*) is produced into a definite projecting lamella, distinctly visible in lateral view. In other species the orifice is merely surrounded by a uniformly sharp-edged rim. In some, again, the dorsal part of the rim is a little curved downwards (fig. 23*a*). The obtuse edge so produced, however, does not approach at all closely to the structure seen in the subgenus *Trypargilum*. The parts on each side of the posterior surface of the propodeum between the central furrow and the lateral surface are termed the "angles of the propodeum" (fig. 21*a*); they are often cross-striate. The lateral surface of the propodeum may merge imperceptibly with the angles or may be separated from the latter by a definite keel (fig. 18*d*), in which case the lateral surface is de-



Figs. 21–25.—(21) Dorsal view of attachment of abdomen to propodeum in *T. rogenhoferi* Kohl. (*a*) Keels of angles of propodeum. (*b*) Keeled depression. (*c*) Dorsal margin of orifice, broad and flattened. (*d*) Dorsal muscle of first tergite. (*e*) Apophysis of first tergite. (*f*) First abdominal tergite (true second). (22) The same in *T. rugifrons* Sm. (*b*) Dorsal margin of orifice, produced into an outstanding lobe. (23) The same in *T. figulus* L. (*a*) Dorsal margin of orifice, narrow, but a little curved downwards. (24) Diagram of right hind coxa of *T. superbum* Sm. (*a*) Inner dorsal keel. (*b*) Emargination for reception of trochanter. (25) The same of *T. cinereum* Cam.

scribed as "defined above." The sculpture of the lateral surface is of some importance; in a few species there is a small curved keel, arising just in front of the hind coxae and curving up towards the keel defining the sides above.

The legs. The fore coxae seen from the side often bear two keels. The more dorsal of these is difficult to see if the coxae are closely appressed to the body. It is absent in certain species. The more ventral keel runs usually at a slight angle to the dorsal one and ends at the postero-ventral corner of the lateral aspect of the coxa. The mid coxa in dorsal view also bears a more or less distinct keel. This is most easily seen if the wasp is examined from above, with its head directed to the observer's right, the keel then being seen on the left coxa, which is then on the side of the wasp directed away from the observer. If the specimen is held in the same position the keel on the inner edge of the dorsal surface of the hind coxa will also be seen, most easily on the right coxa, which is the one nearer to the observer. This keel (fig. 24*a*) starts at the base of the coxa and proceeds along the edge towards the apex. In some species it is very weak or ends before the distal end of the coxa. In others it is strong throughout and in a few African species (group of *T. carpenteri* Richards) the keel is raised into a strong triangular tooth. When the keel is continuous to the apex it may coalesce there with the rim surrounding the emargination (fig. 24*b*) in which the trochanter is articulated or it may be quite distinctly separated from this rim. This is useful as a group character (*e.g.* allies of *T. spinosum* Cam., of *T. superbum* Sm., etc.). In two species-groups (allies of *T. albitarse* F. and *T. fabricator* Sm.) the fore coxa in the female bears a tuft of strong bristles, quite distinct from its general pubescence, at its distal extremity; in the other species only pubescence is present. In the subgenus *Trypoxylon* s.s. (except a few species; notably the groups of *T. marginatum* Cam. and *T. rufidens* Cam.), the ventral surface of the hind coxa of the female bears a very peculiar organ. This usually is in the form of a tubercle with the apex perforated, but it may be only a small oval patch where the cuticle appears to be thinner and is dull and hairy. The organ is situated on the inner edge of the ventral surface of the coxa, often nearer the distal extremity than the base. Its function is very problematical, but its external appearance suggests a sense-organ. The legs do not otherwise differ much between the species except in the group of *T. albitarse* F., where in the males of some species the mid femora are clavate and densely hairy posteriorly towards the apex, while the hind femora are produced ventrally into an apical lamella. In the group of *T. spinosum* Cam., the males have a spine on the hind trochanter and the basal third of the hind femora is slightly emarginate. In the females of this group distinct traces of the trochanteral spine are present in a few species. In a few species (*T. cinereum* Cam., etc.) the hind tibiae are angular instead of cylindrical; this is usually more obvious in the females than the males. The hind tibiae usually bear a few fine bristles on the dorsal and outer surfaces; in some of the males of the group of *T. albitarse* F. these spines are very numerous and more strongly developed.

The wings. The main features of the venation are seen in fig. 26. Details vary considerably even in the same species, but the following characters are sufficiently constant to be of value in defining groups. The costa may end at M_{1+2} (Tillyard's notation) (subgenus *Trypargilum*) or be more or less distinctly produced beyond it. The angle between im_1 and M_{3+4} varies from 80° to 135° or, in the group of *T. rufidens* Cam., these veins form a continuous curve. While the exact size of the angle is not constant, it is possible to group the species into those with the angle at 110–135° (subgenus *Trypargilum*) and those with the angle at 80–100° (most of the remaining species). There are not many species annectent between these two categories. In the hindwings, the hamuli are grouped in two series, a basal and a distal one. The number of hooks in each series and the distance intervening between the groups, which may be expressed as a fraction of the length of the apical group, are moderately constant.

The abdomen. On each side of its proximal end the first tergite is expanded into an apophysis (fig. 21*e*) to articulate with the propodeum. In some species these apophyses are unusually large and may be angular instead of (as usually) rounded. The tergite normally bears a central longitudinal furrow which extends a variable distance from the proximal end. In order to measure the proportions of the tergite I have found it convenient to describe the dimensions of the imaginary area subtended by the spiracles at the base of the abdomen. This is termed the "spiracular area." Its length is measured by the distance from the spiracles to the base of the abdomen and its width by the width of the first tergite, just distally to the apophyses. In certain species (group of *T. albitarse* F.) it is useful to describe also the "apophysal area." The lengths and breadths of the first two abdominal tergites are rather variable owing to contraction after death, but in some species they may provide useful characters. In some species the proximal abdominal tergites are more or less swollen towards their apex, giving the abdomen a knotted appearance in profile. The sixth tergite of the female is usually more or less keeled. In the male the seventh tergite in the subgenus *Trypargilum* is usually keeled, the keel projecting as a hook beyond the apex of the abdomen. The first sternite is usually narrow and without pubescence or sculpture. In the group of *T. albitarse* F., however, it often bears a hook or prominence. In many species

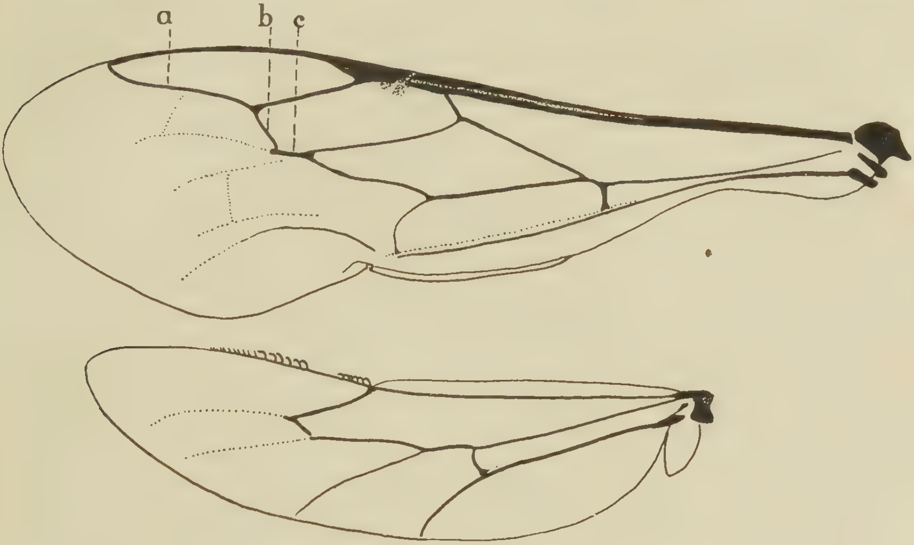


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FIG. 26.—Wings of *T. salti* sp. n. (*a*) M_{1+2} (Tillyard's notation); *Rs* (Bradley's notation). (*b*) im_1 (Tillyard's notation); $Rs + m$ (Bradley's notation). (*c*) M_{3+4} (Tillyard's notation); M_{1+2} (Bradley's notation).

of the subgenus *Trypargilum* the second (sometimes also the third and fourth) sternites are modified in the male, being depressed at the base and swollen and callose at the apex. The eighth sternite in the male is always highly modified and usually hidden under the seventh. In *Trypargilum* (fig. 30) it is always in the form of a small basal piece and two long apical prongs. In *Trypoxylon* s.s. (Pl. VI, figs. 4–12) the sternite is very variable in form, but if emarginate at the apex, the prongs so formed are always quite short. Every sternite has two lines along which is attached the arthrodial membrane by which it is articulated to the sternites in front and behind. The sternite lying anteriorly is attached to the ventral (outer) surface and the posterior sternite to the dorsal (inner) surface. In the case of the eighth sternite the attachment to the seventh coincides with the anterior margin of the eighth. The attachment of the genitalia to the dorsal (inner) surface of the eighth sternite, however, is usually along quite a different line. Sometimes (group of *T. albitarse* F.) the dorsal surface (fig. 30*a*) projects anteriorly to the ventral, but in *Trypoxylon* s.s. the proximal edge of the dorsal surface is usually widely emarginate, sometimes almost as far as the apex of the sternite. The shape of the proximal margin of the dorsal surface seems often to provide a good group-character, but in many of the smaller species it is very difficult to make out and in any case it can only be seen after dissection.

The sternites after and including the second always bear bristles at the apices. In a few groups the number of these bristles is rather constant; it may vary from 2 to 8. In *Trypargilum* the general surface of the sternites is usually bare, except for a little pubescence round the bases of the bristles. In *Trypoxylon* s.s., on the other hand, the sternites are usually pubescent throughout or at least with large triangular areas of pubescence.

The male genitalia. Many species of *Trypoxylon* are still known from a very few examples and sometimes the male is as yet undiscovered. It is, therefore, at present not practical to use the structure of the genitalia as a regular feature of specific diagnosis, particularly as it is very difficult to make out in the smaller species. I have nevertheless found it very valuable in confirming my ideas as to the limits of species-groups, and a representative selection are figured. In the difficult group of *T. albitarse* F. the genitalia have been studied in greater detail and I believe the following generalisations will be found to hold within the genus. Closely allied species which can, however, easily be separated on other structural features, often do not differ at all in the male genitalia, but it is usually possible to recognise several types in each major species-group. It is possible that the genitalia are more specific in *Trypoxylon* s.s., but even here *T. balteatum* Cam. and *T. fabricator* Sm., which are quite distinct though closely allied species, were found to have identical genitalia.

I am not acquainted with any really detailed comparative study of the male genitalia of Aculeate Hymenoptera, though Boulangé (1924) has made a useful summary of some of the main features. The work of Saunder's (1884) is vitiated by insufficient attention to easily verifiable homologies. Many authors do not appear to have examined adequately cleared preparations. In the course of other work I have studied the male genitalia of a considerable number of genera and I believe that a short comparative account would enhance the value of a description of the parts of *Trypoxylon*.

In the abdomen of a male hymenopteron there are normally nine recognisable sternites. The first is incorporated in the propodeum and there are eight in the remainder of the abdomen. In the same way nine or ten tergites are visible. In the Aculeate Hymenoptera the tenth tergite appears to be incorporated in the ninth. Since the full complement of the tergites and sternites is present, the genitalia themselves must consist only of the appendages of the ninth sternite, a matter of great importance in determining homologies.

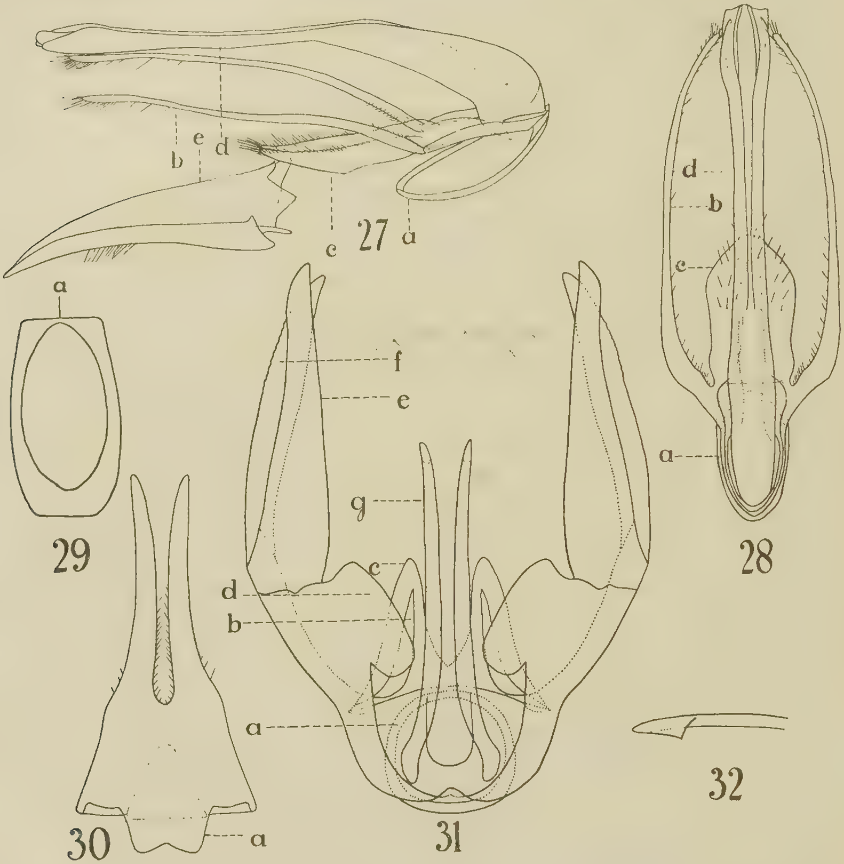
It is not possible in my opinion to homologise with certainty the parts of the hymenopterous male genitalia with those of less specialised orders. I therefore propose to employ non-committal terms for purposes of description. A great number of such terms have been coined by different authors, a tabular account of the nomenclature being presented by Boulangé. I believe that a system almost identical with that propounded by Thomson is the most satisfactory. In the ensuing description (as in the previous account of the abdomen) the propodeum is not enumerated as an abdominal segment.

The proximal part of the genitalia is the *cardo*, a ring often somewhat flattened and usually showing distinct traces of its origin from a right and left half. The remaining parts are articulated to the posterior edge of the cardo, of which the anterior margin is joined by membrane to the eighth sternite and eighth (ninth) tergite. These remaining parts consist of two pairs of outer sclerites and an unpaired central organ. The latter is the aedeagus, which is essentially a cylindrical tube pierced by the *ductus ejaculatorius*. In the Hymenoptera each side of the tube is strongly sclerotised and each lateral wall is termed a *sagitta*. Proximally each sagitta is produced into an *apophysis* for muscle-attachment. The floor of the tube is membranous and the roof also in many forms. Where the roof is also heavily sclerotised (APIDAE), the structure so formed is termed the *spatha*. Of the paired sclerites, the outer pair consists of a *stipes*, bearing at its apex a *squama*. The inner pair, which is closely articulated with the inner edge of the stipes, is termed the *volsella* (lacinia of Thomson). In generalised forms, such as most sawflies, the volsella also consists of two parts, a basi-ventral part, which has a proximal apophysis for muscle-attachment, and an apico-dorsal one, lying more posteriorly and often projecting beyond the squama.

In homologising these parts with corresponding ones of a generalised insect, the chief difficulty is presented by the cardo. It appears possible that this structure represents the fused bases of the coxites, while the stipes and squama represent the rest of the coxites and their style. The volsella would then represent 2-segmented parameres. It is possible that an embryological study would permit a definite decision.

Within the Hymenoptera specialisation seems to take two lines. First, the parts may assume all sorts of bizarre shapes, sometimes even in the species of a single genus. Secondly, there may be great simplification owing to the fusion of parts. It appears to be the rule in each main division of the Aculeates that the more generalised forms have the more complex genitalia owing to the retention of the full number of possible sclerites. It is not possible at the moment to use the male genitalia to any great extent in classification because several of the reduction-stages may occur in a single family or even genus. As a corollary to this, it is frequently found that homologising the parts in a particular genus may be very difficult if only a single species is studied. By examining additional members of the genus doubtful structures can often be interpreted. When the stipes and squama are fused together, the compound structure is termed the "stipes-squama." The stipes appear never to be pubescent, so that even fused portions of the squama or volsella may often be distinguished from them.

The genus *Trypoxylon* is rather isolated amongst the Sphecoidea. The genera *Pison* and *Aulacophilus* appear to be quite closely allied, but the small family so formed is not very close to any other. Probably some of the LARRIDAE (*Nitela*, *Miscophus*) are the nearest allies, but there appear to be also some points of resemblance to the CRABRONIDAE. In the most generalised type in the genus *Trypoxylon* (some of the species of the group of *T. fabricator* Sm., fig. 31) all the parts are clearly visible. The cardo (fig. 29) is always in the form of a narrow ring. The stipes are quite distinct but often very narrow. The squama is sometimes quite distinct (*Trypoxylon* s.s.), but in the subgenus *Trypargilum* (figs. 27 and 28) it is completely fused with the stipes. Throughout the genus there is a tendency for the basi-ventral volsellae of each side to meet on the mid-ventral line and fuse to a varying extent. In the species of the subgenus *Trypargilum* they form a single central lobe, the only indication



FIGS. 27–32.—(27) Male genitalia of *T. palliditarse* Sauss., seen from the right side. (*a*) Cardo. (*b*) Right stipes. (*c*) Volsellae. (*d*) Sagitta. (*e*) Eighth sternite. (28) The same in dorsal view. The same lettering. (29) Cardo of *T. palliditarse* Sauss., in ventral view. (*a*) Posterior end. (30) Dorsal view of eighth sternite of *T. palliditarse* Sauss., male. (*a*) Basal process to which the cardo is attached. (31) Dorsal view of the male genitalia of *T. fabricator* Sm. (*a*) Cardo. (*b*) Apico-dorsal volsella. (*c*) Basi-ventral volsella. (*d*) Basal lobe of stipes. (*e*) Stipes. (*f*) Squama. (*g*) Sagitta. (32) Apex of sagitta of *T. fabricator* Sm., seen from the side.

of a paired origin being a distal emargination. In *Trypoxylon* s.s. the apico-dorsal volsella is usually more or less recognisable, but in *Trypargilum* it has disappeared. A definite spatha is never developed, but the sagittae are distinct, though their apophyses are weak or absent. The shape of the sagittae appears to be a good character for the division of the species into minor groups.

In the genus *Pison* (*P. atrum* Spin., studied), the genitalia are superficially rather dissimilar. The cardo is much larger, especially in dorsal aspect. The stipes-squama is broad and the squama seems to be relatively larger. The basi-ventral volsellae are fused across the mid-ventral line as in *Trypoxylon*, but they are also fused with the stipes; there is a distinct apico-dorsal volsella. In the LARRIDAE, a volsella in some respects not unlike that of *Trypoxylon* is seen in *Notogonidea pompiliformis* Pz., but most genera of the family are quite distinctive. *Notogonidea* itself is widely different in other parts of the genitalia. Generally speaking the lateral view of the genitalia in the LARRIDAE shows a very high profile, especially in the region of the cardo. This is rarely the case in *Trypoxylon*.

KEY TO THE SPECIES-GROUPS.

1. Dorsal edge of orifice of propodeum broad and flattened, at most somewhat sloping downwards in centre. Costa not produced beyond the radial cell in fore-wings. Abdominal sternites 2–3, usually 2–5, bare and shining (except *T. triodon* sp. n. and the group of *T. superbum* Sm.) with only a little scattered pubescence around the bases of the paired bristles. Male eighth sternite produced posteriorly into two long spines. Two groups of hamuli on hind-wings usually separated by not more than length of apical row. *Trypargilum*, subgen. n. Type *T. nitidum* Sm. (Confined to America.) . . . . 2.

—. Dorsal edge of orifice of propodeum narrow, usually sharp-edged, sometimes projecting in a small lobe; at most a little downcurved, even then not very broad and flattened. Costa usually produced beyond the radial cell in the fore-wings. Abdominal sternites 2–5 more or less pubescent, at least with a central patch of pubescence (except in *T. fiebrigi* sp. n.). Male eighth sternite sometimes bifurcating posteriorly but the arms never long and spine-like. Two groups of hamuli on hind-wings separated by much more than length of apical row. Metapleural keel usually straight. *Trypoxylon*, s.s. Type *T. figulus* L. (Cosmopolitan.) . . 6.

2. Metapleural keel straight. Large black species with dark wings and hind tarsi largely white . . . . Group of *T. albitarse* F.

—. Metapleural keel strongly curved. A few doubtful species are quite differently coloured . . . . 3.

3. Vertex with a fine central keel which meets or nearly meets a transverse one at right angles to it at a point slightly anterior to median ocellus. Pro-episternal keel and pleural suture obsolete. Metapleural keel moderately curved . . . . Group of *T. superbum* Smith.

—. Vertex without a keel at right angles to the central keel . . . . . 4.

4. Lateral lobe of postnotum extremely large, forming big, ear-like expansion, usually of a testaceous colour. Male hind trochanters with a spine or, if not, propodeum with dorsal tubercles. Prepectus with no dorsal or ventral keel . . . . Group of *T. spinosum* Cameron.

—. Lateral lobe of postnotum much smaller, edge of lamella hyaline and a little downcurved (*T. mutatum* Kohl has a rather large lobe). Male hind trochanters simple (except *T. orizabense* sp. n.); propodeum very rarely with tubercles and then only in black species with bright silvery pubescence . . . . 5.

5. Large species. Hind tarsi with apex of basitarsus and whole of second to fourth segments white. Insect almost entirely black with more or less darkened wings . . . . Group of *T. punctulatum* Taschenberg.

—. Species usually smaller. Hind tarsi never so considerably white, very rarely white at all. If first segment is pale then base is paler than apex. Abdomen often with pale markings; wings usually pale Group of *T. nitidum* Smith.

6. Lateral lobes of postnotum raised into high, transparent lamellae. (Female hind coxa sometimes with a ventral organ; pleural suture rarely developed; American species.) . . . . 7.

—. Lateral lobes of postnotum usually little raised, black. At most somewhat raised and narrowly hyaline anteriorly . . . . 8.

7. Limiting keels of antennal scrobes forming a central keel bifurcating above. Abdominal sternites glabrous. Female hind coxa with a large ventral pit whose bottom is membranous . . . . Group of *T. fiebrigi* sp.n.

—. Limiting keels of antennal scrobes forming a straight or angulated transverse keel, or absent. Abdominal sternites pubescent. Female hind coxa sometimes with a small ventral tubercle . . Group of *T. fabricator* Smith.

8. Pleural suture strong for more than half the height of pleuron. Black species with at most legs partly pale. Limiting keels of antennal scrobes forming a central keel (sometimes very short), bifurcating above and sometimes below; above often enclosing a more or less defined heart-shaped area on vertex, not including the median ocellus. Eyes not closer together at clypeus than on occiput. Clypeus nearly always broader than high. Hind coxa of female simple. (American species.) Group of *T. marginatum* Cameron.

—. Pleural suture not developed (except in *T. staudingeri* sp. n. in which the limiting keels of antennal scrobes form a straight transverse keel) . . 9.

9. Limiting keels somewhat as in the group of *T. marginatum* but not completely fused below where usually several long bristles arise from between them; above, if complete, enclosing the median ocellus. Fore-wings with im_1 and M_{3+4} usually forming an acute angle. Hind-wings usually with twice as many hamuli in basal row as in apical. Inner dorsal keel of hind coxa not produced into a tooth. Female hind coxa with a ventral organ . . . . Group of *T. scutatum* Chevrier.

—. Limiting keels, if produced back on vertex then with no single central section and the posterior arms subparallel. Or else the inner dorsal keel of the hind coxa produced into a tooth . . . . 10.

10. Mandibles of female broad, bidentate. Clypeus of female thickened at apex, with two small emarginations, through which pass finger-shaped processes of the labrum. Head quadrate above, limiting keels of antennal scrobes diverging posteriorly, the arms sub-parallel, defining a subrectangular raised area whose anterior margin is rounded. Thorax and propodeum very elongate. Junctions between abdominal tergites 1–2, 2-3 and 3–4 very deeply incised, especially in the female. Metapleural keel a little curved. Fore-wings with im_1 and M_{3+4} usually forming a continuous curve. Hind coxae of female simple. (American species.) Group of *T. rufidens* Cameron.

—. Mandibles of female rarely bidentate. Labrum at most bilobed. Limiting keels of antennal scrobes quite different in structure . . . . . . 11.

11. Mandibles of female broad, bidentate. Head quadrate. Limiting keels of antennal scrobes not developed. Abdomen with tergites not incised. Fore-wings with angles between im_1 and M_{3+4} rectangular. Female hind coxae simple. Male with only twelve antennal segments. (One Indian species.) . . . . Group of *T. mandibulatum* Richards.

—. Mandibles simple . . . . 12.

12. Small species with short wings. Sculpture exceedingly strong, honeycomb-like. Metapleural keel distinctly curved. Female hind coxae with a tubercle. (Old World species.) . . . Group of *T. brevipenne* Saussure.

—. Sculpture usually very much weaker. Metapleural keel nearly straight . 13.

13. Hind coxa with inner dorsal keel produced into a strong angular tooth. Limiting keels of antennal scrobes sometimes tending to form the structure seen in *T. scutatum* Chevr. (African species.)
Group of *T. carpenteri* Richards.

—. Inner dorsal keel of hind coxae weak, not forming a tooth. Female usually with a ventral organ on hind coxa . . . . . Group of *T. figulus* L.

KEY TO GROUP OF *T. ALBITARSE* FABRICIUS.

Males.

1. First abdominal sternite not produced into a hook.
(Stipes of maxilla not raised into a tubercle. Posterior emargination of metasternum V-shaped. Distance between points of mesosternal lobes 2–2½ times their length. Mid femora not thickened, with only short hairs below. Squama of genitalia raised basally into a dorsal lamella, or with elongate, inner, ventral serrations. Sagittae recurved at apex into broad lobes or narrow hooks. Clypeus with no outstanding process. Hind tibiae with at most 3–4 anterior spine-like bristles.) . . . . 2.

—. First abdominal sternite with no hook. All other characters as in subgroup of *T. palliditarse*, except basal process of eighth sternite not emarginate. Clypeus with an outstanding process . . . . . . *T. schnusei* sp. n.

—. First abdominal sternite produced into a hook.
(Stipes of maxilla raised into a pointed tubercle. Posterior emargination of metasternum in the form of a large, flat-bottomed U. Distance between the points of the mesosternal lobes fully 3 times their length. Mid femora strongly thickened with dense, long hairs posteriorly. Squama of genitalia simple at base. Sagittae somewhat swollen at apex, but not recurved. Basal process of eighth sternite emarginate. Hind tibiae with 8–15 strong, antero-dorsal spines in an irregular double row. Length 15–21 mm.) . . . . 9.

2. Hind femora ventrally raised into a lamella near apex.
(First abdominal sternite with a basal hump or prominence. Squama of genitalia with long interno-ventral, basal serrations. Each sagitta with a dorsal and lateral hook at apex. Basal process of eighth sternite emarginate. Clypeus apically raised and, seen from beneath, thickened. Length 17–21 mm.). Subgroup of *T. poultoni* sp. n. . . . . 3.

—. Hind femora clavate but not raised into a lamella.
(First abdominal sternite simple. Squama of genitalia raised into a thin, dorsal, basal lamella. Each sagitta recurved into a broad, dorsal lobe. Basal process of eighth sternite not emarginate. Clypeus apically twice emarginate, little raised, not thickened. Length 14 mm.). Subgroup of *T. fuscipenne* Fabricius . . . . 5.

3. Fifth segment of hind tarsi dark brown. Hump on first abdominal sternite covering more than one-third of its length, closely punctured.
(Raised part of clypeus sinuate laterally; thickened part beneath this with its lower margin curved, the cresentic area so formed three times as broad as high. Apophysal area of first tergite a little broader than long. Lamella of hind femora three times as broad as high. Ocelli separated by about their diameter from eyes.) . . . . *T. poultoni* sp. n.

—. Fifth segment of hind tarsi white. Hump on first abdominal sternite covering rather less than one-third of its length, unpunctured . . . 4.

4. Raised part of clypeus not at all sinuate laterally. Thickened part beneath with its lower edge straight, the arc so formed two and a third times as broad as high. Ocelli separated by rather less than their diameter from eyes. Apophysal area of first tergite nearly twice as broad as long. Lamella of hind femora three times as broad as high . . *T. busckii* sp. n.

—. Raised part of clypeus sinuate laterally. No definite area beneath it, the ventral surface passing straight from the apical margin of the clypeus towards the base of the labrum. Ocelli separated by half their diameter from eyes. Apophysal area of first tergite a little broader than long. Lamella of hind femora five times as broad as high . *T. barticense* sp. n.

5. Apical emargination of clypeus strong but with no central tooth. Apophysal area of first tergite about three times as wide at base as long, the apophyses angularly projecting.
(Size large. Hind femora at thickest point fully twice its basal diameter. Fifth segment of hind tarsi nearly black.)
T. albonigrum sp. n.

—. Apical emargination of clypeus a little weaker and bearing a central tooth. Apophysal area never more than two and a half times as long as wide at base. Size smaller . . . . 6.

6. Apophyses angularly projecting. Apophysal area one and two-thirds times as wide at base as long. Hind femora at their thickest point one and three-quarter times as thick as basal diameter.
(Ocelli separated by a little more than their diameter from eyes. Fifth segment of hind tarsi white. Basal lamella of squama moderately broad not angulated.) . . . . 7.

—. Apophyses angularly projecting. (Other characters as in *T. aestivale* sp. n.)
T. aestivale sp. n., var.

—. Apophyses rejoining sides of tergite at an imperceptible angle . . . . 8.

7. Occiput alutaceous. Mesopleuron with very fine and sparse punctures. Apex of the prongs of eighth sternite scarcely dilated . *T. atkinsoni* sp. n.

—. Occiput not alutaceous, very shining. Mesopleuron absolutely unpunctured. Apex of prongs of eighth sternite strongly dilated, spatulate
T. spatulatum sp. n.

8. Ocelli separated by one and a half times their diameter from eyes. Apophysal area twice as broad at base as long. Spiracular area fully twice as long as broad. Hind femora at their thickest point two and a half times as thick as their basal diameter. Basal lamella of squama very broad, angulated. Fifth segment of hind tarsi brown
T. aestivale sp. n.

—. Ocelli separated by about their diameter from eyes. Apophysal area two and a half times as broad at base as long. Spiracular area nearly three times as long as broad. Hind femora at their thickest point twice as thick as their basal diameter. Basal lamella of squama hardly developed. Last segment of hind tarsi white or pale, yellow-brown
T. fuscipenne Fabricius.

9. Clypeus with an outstanding process before its apex.
(Hind femora with the ventral lamella including one-third to one-half its length.) Subgroup of *T. palliditarse* Saussure . . . . 10.

—. Clypeus with no outstanding process, apical margin with four weak teeth.
(Hind femora with the ventral lamella not including more than one-fifth of its length. Ventral emargination beneath the hook of first sternite not extending anteriorly to spiracles of first tergite.) Subgroup of *T. albitarse* Fabricius . . . . 15.

10. Clypeus on each side with an apico-lateral tooth and another (not quite on margin) between the apico-lateral tooth and the base of the outstanding process.

(Ventral thickening of first sternite, preceding the hook, about twice as long as hook; emargination beneath the hook not nearly extending as far as spiracles of first tergite; discal impression of posterior part of first sternite with sides strongly sinuate.) . . . . 11.

—. Clypeus on each side with apico-lateral tooth only . . . . 12.

11. Outstanding process of clypeus with its apical margin rounded *T. gandarai* Rohwer (not seen).

—. Outstanding process of clypeus with its apical margin angulated *T. mexicanum* (Saussure) Rohwer.

12. Outstanding process of clypeus twice as long as broad, the bare area beneath it one and a half times as broad as high; apico-lateral teeth triangular.

(Ventral thickening of first sternite, preceding the hook, about twice as long as hook; emargination beneath hook hardly extending as far as spiracle of first tergite. Ocelli separated by one and a half times their diameter from eyes. Discal impression of posterior part of first sternite with sides strongly sinuate.) . . . . *T. buchwaldi* sp. n.

—. Outstanding process of clypeus at most a little longer than broad, the bare area beneath it at least twice as broad as high; apico-lateral teeth quadrate.

(Ventral thickening of first sternite, preceding the hook, as long as or shorter than the hook; discal impression of posterior part of sternite with sides nearly straight.) . . . . 13.

13. Size small, length 15·5 mm. Ocelli separated by one and two-thirds times their diameter from eyes. Emargination beneath hook of first sternite extending back as far as spiracles of first tergite; hook quite straight *T. bryanti* sp. n.

—. Size larger, length 16–21 mm. Ocelli separated by one and half times their diameter or less from eyes. Emargination beneath hook extending to a point nearer to end of apophyses than to spiracles of first tergite . . 14.

14. Ocelli separated by one and a half times their diameter from eyes. Hook of first sternite strongly curved.

(Clypeus with outstanding process one and a half times broader than long, separated from apico-lateral tooth by a little less than one and a half times its width. Area beneath process with a flat part immediately beneath process and a narrow lateral arm at each side connecting this with the apico-lateral tooth; this lateral piece lying at a different level from the flat area, which is twice as broad as high.) . *T. melanoleucum* sp. n.

—. Ocelli separated by a little more than their diameter from eyes. Hook of first sternite nearly straight. Clypeus with outstanding process usually a little longer than broad, separated from the apico-lateral teeth by two and a half times its apical width. Area beneath the process flat, four times broader than high . . . . *T. palliditarse* Saussure.

15. Hook of first sternite very strongly curved, the emargination beneath it not nearly extending to spiracles of first tergite (actually the anterior edge of base of hook is opposite these).

(Clypeus as in *T. albitarse* F. Apophysal area three and a half times as broad as long.) . . . . *T. neglectum* Kohl.

—. Hook of first abdominal tergite less curved, the emargination beneath it extending as far as spiracles of first tergite . . . . 16.

16. Apophysal area of first tergite three and a half times as broad as long. Lateral teeth at apex of clypeus blunter, situated outside the tangent to inner margin of eye . . . . *T. politiforme* Rohwer.

—. Apophysal area of first tergite two and a half times as broad as long. Lateral teeth at apex of clypeus sharper, situated inside the tangent to inner margin of eyes . . . . *T. albitarse* Fabricius.

*Females.**

1. Pubescence black . . . . 2.
—. Pubescence whitish . . . . 3.
2. Mandibles reddish, yellowish at base. Apophyses of first tergite angular *T. mexicanum* (Saussure) Rohwer (agg.).
—. Mandibles black or pitchy, always darker at base than apex. Apophyses rounded . . . . *T. albitarse* Fabricius (agg.).
3. Large species. Mesonotum more strongly punctured. Clypeus normally strongly keeled for most of its length. Pronotal angles rounded. Inner dorsal keel of hind coxae obsolete, or nearly . . . . 4.
—. Small species. Mesonotum weakly punctured. Clypeus normally practically unkeeled. Pronotal angles prominent. Inner dorsal keel of hind coxae quite strong on basal half . . . . 6.
4. Ocelli separated by half their diameter (a little more or less) from eyes. Fifth segment of hind tarsi white . . . . *T. barticense* sp. n. (agg.).
—. Ocelli separated by their diameter or more from eyes. Fifth segment of hind tarsi dark, rarely basal half pale . . . . 5.
5. Central truncation of clypeus distinctly shorter than distance from one of its angles to upper edge of mandibular articulation *T. palliditarse* Saussure (agg.).
—. Central truncation very broad, about twice this distance . *T. buchwaldi* sp. n.
6. Ocelli separated by one- to two-thirds their diameter from eyes. Fifth segment of hind tarsi white . . . . *T. fuscipenne* Fabricius (? agg.).
—. Ocelli separated by rather less than one to one and a half diameters from eyes. Fifth segment of hind tarsi dark brown . *T. aestivale* sp. n. (agg.).

KEY TO GROUP OF *T. SUPERBUM* SMITH.

Females.

1. Occiput just behind lateral ocelli raised into a fine transverse keel. Transverse keel on vertex distinctly longer than distance between outer edges of lateral ocelli, not joined to median ocellus by a furrow. Ocelli separated by one-third their diameter from eyes. Mesonotum sparsely and very obsoletely punctured, shining. Pronotum only yellow tinged *T. olfersi* sp. n.
—. Occiput not keeled behind the ocelli. Transverse keel on vertex at most as long as distance between outer edges of ocelli . . . . 2.
2. Ocelli separated by two-thirds their diameter from eyes. Transverse keel on vertex hardly longer than distance between the lateral ocelli, not joined to the median ocellus by a furrow. Eyes rather closer together at clypeus than on occiput. Antennae, clypeus, mandibles, thorax and abdomen almost entirely black. Mesonotum closely and finely punctured, rather dull . . . . *T. cariniceps* sp. n.
—. Ocelli separated by half their diameter or less from eyes . . . . . . 3.
3. Eyes at clypeus slightly further apart than they are on occiput. Mesonotum finely and closely punctured, alutaceous, dull. Transverse keel of vertex joined to median ocellus by a very weak furrow. Pronotum black, antennae except dorsal side of segments 2–7, most of legs and base of abdominal segments 2–3, yellow . . . . *T. saundersi* sp. n.
—. Mesonotum very obsoletely punctured, more shining. Eyes at clypeus as far or less far apart than they are on occiput. Antennae darker . . 4.

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* It is still not entirely possible to identify the females. I have therefore used the expression "agg." (aggregate) to indicate that a group is involved.

4. Transverse keel of vertex joined to median ocellus by a weak furrow. Eyes at clypeus and on occiput equally separated. Mandibles pitchy, pronotum and most of abdomen black . . . *T. carinifrons* Cameron.

—. Transverse keel of vertex joined to median ocellus by a distinct furrow. Eyes at clypeus distinctly closer together than they are on occiput. Mandibles, at least part of pronotal collar and often most of abdomen yellowish . . . . 5.

5. Length 14 mm. Four or five apical segments of antennae dark. Supra-antennal keel longer. Pronotum and most of abdomen pale *T. superbum* Smith.

—. Length 12·5 mm. All antennal segments pale beneath. Supraantennal keel shorter. Pronotum and abdomen mostly pale var. *fulvipes* Cameron.

—. Length 14 mm. Antennae almost entirely dark. Supraantennal keel short. Pronotum with only hind margin of collar pale; abdomen almost entirely dark. Wings darker . . . var. *superciliosum* var. n.

Key to the known Males.

1. Eyes abnormal, the lower part much more convex than the upper. Clypeus quadridentate . . . . *T. monstrificum* Kohl.

—. Eyes normal . . . . 2.

2. Clypeus quadridentate, the two central teeth more projecting than the outer ones . . . . *T. superbum* Smith.

—. Clypeus tridentate, the central tooth much stronger than the two lateral ones . . . . *T. carinifrons* Cameron.

KEY TO GROUP OF *T. SPINOSUM* CAMERON.

1. Supraantennal keel strongly raised, broadly truncate posteriorly, truncation at least as big as median ocellus. Inner dorsal keel of hind coxae moderately strong, at apex contiguous to emargination for reception of trochanter.

(Ocelli separated by two-thirds their diameter or more from eyes. Limiting keels of antennal scrobes not developed. Traces of dorsal keel to prepectus often present. Male hind trochanter simple, but dorsal area of propodeum raised into spines posteriorly (sometimes also in female) . . . . 2.

—. Supraantennal keel little raised, narrowly truncate. Inner dorsal keel of hind coxae stronger, reflexed at apex where distinctly separated from emargination for reception of trochanter (except in *T. nattereri* sp. n. which is known by the dull, densely alutaceous vertex).

(Propodeum simple. Hind trochanter of male with a ventral spine or lamella.) . . . . 3.

2. Abdomen with a distinct red band. Sides of propodeum punctate-striate, dorsal area posteriorly with a tubercle on each side in both sexes (sometimes weak in female) . . . . . . *T. tridentatum* Packard. ♂♀.

—. Abdomen only slightly reddish at sides basally. Sides of propodeum with scarcely visible traces of striae, dorsal area with tubercles in male only *T. projectum* Fox. ♂♀.

3. Ocelli separated by about three-quarters their diameter from eyes. Base of antennae, of abdomen and legs except femora, reddish. Pubescence dense, brassy . . . . *T. texense* Saussure. ♂♀.

—. Ocelli separated by two-thirds their diameter or less from eyes . . . . 4.

4. Very large species, length about 20 mm. Central area of propodeum very strongly depressed, hardly striate, bounded laterally by smooth prominences. Occiput behind the ocelli rather strongly raised, very shining, hardly punctured. Limiting keels of antennal scrobes strong, as long as scape. Male hind trochanter with a lamella not a spine . . . . . 5.

—. Smaller species, length 16 mm. or less. Central area of propodeum less depressed, boundaries usually sculptured. Occiput behind the ocelli often less raised and usually punctured. Male hind trochanter with a spine . . . . 6.

5. Abdomen black. Antennae with segments 2–5 reddish beneath. Wings greyish with apex darker. Mid trochanter of male simple *T. apicipenne* Cameron. ♂♀.

—. Second abdominal tergite red. Antennae with segments 1–7 red. Wings yellow-brown. Mid trochanter of male with a rounded ventral swelling near apex . . . . *T. bicalcaratum* sp. n. ♂.

6. Vertex between the ocelli shining, sparsely and not strongly punctured. Vertex distinctly shining with very large, close, shallow punctures, the boundaries between which are rounded; central impression strong. Supraantennal keel and limiting keels strong. Abdomen with apex of first tergite, whole of second and base of third red *T. campaspe* sp. n. ♀.

—. Vertex between ocelli dull, alutaceous, usually very closely punctured; or if more shining there, vertex with confluent punctures . . . . . 7.

7. Vertex dull, densely alutaceous, with rather small, very shallow, flat-bottomed punctures, separated by their diameter. Proepisternum with rather strong teeth at sides and weak ones at centre, keel obliterated between. Mesonotum and mesopleuron rather closely and strongly punctured. Abdomen not conspicuously red at base *T. nattereri* sp. n. ♀.

—. Vertex usually moderately shining, even if somewhat alutaceous, with very large, subconfluent punctures . . . . 8.

8. Occiput rather strongly raised behind the lateral ocelli, strongly impressed between the prominences, both prominences and depression very shining, unpunctured. Dorsal area of propodeum with central triangle coarsely striate, longitudinally at base, transversely at apex, sides bounding triangle coarsely clathrate. Hind metatarsi largely white . . . . 9.

—. Occiput rarely much raised, at least depression between the prominences distinctly punctured. Dorsal area of propodeum with central triangle finely cross-striate or hidden by pubescence, sides bounding triangle punctured or finely striate (except *T. johannis*). . . . . 10.

9. Abdomen black, at most sides of tergites 1–2 red-tinged *T. clavatum* Say. ♂♀.

—. Abdomen with sides of first tergite and greater part of second bright red var. *cockerellae* Rohwer. ♀.

10. Dorsal area of propodeum basally irregularly striate, angles with very coarse irregular striae. Thorax strongly and closely punctured. Wings dark brown, pronotal collar, legs and first two abdominal segments red *T. johannis* sp. n. ♂♀.

—. Dorsal area of propodeum with finer and more regular striae. Wings paler. 11.

11. At least apex of first abdominal segment and whole of second and base of third red. Pubescence silvery. Proepisternal keel not forming teeth . 12.

—. At most sides of first and base of second abdominal segments reddish. Proepisternal keel usually forming teeth . . . . 13.

12. Apex of first segment, whole of second, base of third red. Mesonotum and mesopleuron more strongly punctured. Legs black. Pubescence not unusually dense. (Mexico.) . . . . . . *T. sonorense* Cameron. ♂♀.

—. Greater part of both first and third abdominal segments red. Legs black. Pubescence very bright and dense. (Arizona, California.) *T. arizonense* Fox. ♂♀.

—. Greater part of abdomen and legs indeterminately reddish. Pubescence not dense. Sculpture of head coarser. (Yúčatan.)
T. fusciventre Cameron. ♀.

13. Pubescence silvery, not very dense on propodeum. Punctures of mesothorax rather coarser and closer. Hind tarsi nearly always partly whitish . . . . *T. spinosum* Cameron. ♂♀.

—. Pubescence bright brassy, very dense on propodeum, hiding sculpture. Punctures of mesothorax rather finer and sparser. Hind tarsi dark
T. salti sp. n. ♂♀.

—. Pubescence silvery, sparse, particularly on the propodeum. Punctures of mesothorax very fine, on sides of propodeum nearly obsolete. Hind tarsi partly white . . . . *T. armatum* Taschenberg. ♂♀.

KEY TO THE GROUP OF *T. PUNCTULATUM* TASCHENBERG.

1. Mesonotum densely and strongly punctured, anteriorly alutaceous, dull. Vertex with large dense punctures. Apex of clypeus with two blunt teeth and a minute emargination on each side of them. Ocelli separated by their diameter from eyes. Pleural suture well developed. Last segment of hind tarsi black . . . . *T. punctulatum* Taschenberg. ♀.

—. Mesonotum shining, not densely or coarsely punctured . . . . . . 2.

2. Mesonotum and mesopleuron very shining, very finely and sparsely punctured. Vertex alutaceous with large, distinct, rather close punctures. Apex of clypeus with a small, semicircular emargination, partly filled in at a lower level, and a small emargination on each side of it. Ocelli almost touching eyes. Pleural suture strong, extending one-third of the way up the pleuron. Last segment of hind tarsi white. Size small.
T. pectorale sp. n. ♂♀.

—. Mesonotum and mesopleuron distinctly punctured, and at least moderately closely. Vertex either confluently punctured or with the punctures scarcely visible in the general rugosity of the surface . . . . . . 3.

3. Clypeus of male with a broad emargination (covering two-thirds of apical width) defined at sides by small teeth; in centre with a strong outstanding tooth beneath which is a small subrectangular plate about three times as broad as high. Clypeus of female with a distinct central keel on its apical half or third; apex with two blunt teeth and a small emargination on each side of them. Ocelli separated by one-half to one diameter from eyes . . . . 4.

—. Clypeus in both sexes subtruncate or slightly emarginate at apex: that of female not keeled. Ocelli separated by one-quarter to one-half their diameter from eyes . . . . 5.

4. Central process of male clypeus broader, nearly as broad as the plate beneath it. Mesonotum with punctures on disc very fine and sparse, separated by four to five times their diameter. Size smaller. Wings nearly hyaline . . . . *T. bensoni* sp. n. ♂.

—. Central process of male clypeus narrower, not half as wide as plate beneath. Mesonotum more closely punctured, punctures separated by two to three times their diameter. Size larger; wings distinctly darkened
T. rogenhoferi Kohl. ♂♀.

5. Furrow of posterior surface of propodeum continuous with the keeled depression. Pleural suture extends half-way up the pleuron. Mesonotum rather more strongly punctured. Supraantennal keel stronger.
T. surinamense sp. n. ♀.

—. Furrow of posterior surface of propodeum well separated from keeled depression. Pleural suture absent or very short. Mesonotum not so strongly punctured. Supraantennal keel weaker.
T. cinereum Cameron. ♂♀.

KEY TO GROUP OF *T. NITIDUM* SMITH.

1. Apical half of clypeus centrally keeled, central third (seen from beneath) thickened, shallowly emarginate, emargination defined by small teeth; over this thickened area the central keel projects as a strong hook (stronger in the male). Ocelli separated by two-thirds their diameter from eyes. Mesonotum smooth, finely and closely punctured. Prepectus with a strong ventral furrow . . . . *T. tenoctitlan* sp. n. ♂♀.
—. Clypeus with no outstanding hook at apex . . . . 2.
2. Mesonotum strongly and confluently, or at least very closely, punctured, dull. Pronotal collar with angles distinctly bordered . . . . . 3.
—. Mesonotum rarely strongly, never confluently punctured. Usually shining, only alutaceous in one species . . . . 5.
3. Prepectus with a strong ventral keel. Ocelli separated by half their diameter from eyes. Supraantennal keel weak. Apex of clypeus with three teeth in male, four weaker ones in female. Wings subhyaline *T. mutatum* Kohl var. *confluens* var. n. ♀.
—. Prepectus with no ventral keel . . . . 4.
4. Ocelli, separated by one-third their diameter from eyes. Supraantennal keel quite strong, posterior truncation nearly as large as median ocellus. Apex of clypeus weakly emarginate. Wings subhyaline *T. fractum* sp. n. ♀.
—. Ocelli separated by their diameter from eyes. Supraantennal keel weak. Apex of clypeus with two teeth. Fore-wings with costal half brown or yellowish . . . . *T. melanopteron* sp. n. ♂♀.
5. Inner dorsal keel of hind coxae strong, extending to apex, where it is stronger and widely separated from emargination for reception of trochanter. Black species with very conspicuous silvery pubescence, wings with radial cell and apex sharply darker. Pleural suture not or hardly developed. Sides of dorsal surface of propodeum usually more or less raised, especially in the male. Proepisternum with strong teeth at sides and centre. Species of the Greater Antilles . . . . 6.
—. Inner dorsal keel of hind coxa ending before apex or running into keel bounding emargination for reception of trochanter. Coxal structure nearly similar to last section in *T. vagum*, *T. mendozanum*, *T. orizabense* and *T. scrobiferum*, but these have the pleural suture well developed. Colour usually quite different . . . . 13.
6. ♂♂ . . . . 7.
—. ♀♀ . . . . 11.
7. Posterior lateral angles of dorsal surface of propodeum with lamelliform spines . . . . 8.
—. Propodeum without spines . . . . 9.
8. Sternites 2–3 each with a distinct transverse callosity just before apex *T. cubense* sp. n. Cuba.
—. Apex of sternite 2 with a very strong central callosity, apex of sternite 3 with a strong one on each side . . . . *T. rohweri* sp. n. Haiti.
9. Second and third sternites each with a strong rounded, callosity on each side before apex. Sides of dorsal surface of propodeum strongly raised, but rounded . . . . *T. excavatum* Smith. Haiti and Jamaica.
—. Callosities weaker and single, at least on second sternite . . . . . . 10.
10. Sides of dorsal surface of propodeum distinctly raised. Third sternite with a distinct subapical callosity, sternites four and five with traces of callosities . . . . *T. mayri* sp. n. Cuba.
—. Dorsal surface of propodeum nearly flat. Third sternite with two weak callosities, fourth and fifth sternites simple *T. subimpressum* Smith. Haiti and Cuba.

11. Prepectus with a strong ventral keel. Supraantennal keel rather weak. Apex of clypeus rounded . . . . *T. rohweri* sp. n. Cuba.

—. Prepectus with no ventral keel. Supraantennal keel stronger . . . . 12.

12. Apex of clypeus rounded. Striae of angles of propodeum weaker. Larger species . . . . *T. mayri* sp. n. Cuba.

—. Apex of clypeus with a slight emargination. Striae of angles of propodeum stronger. Smaller species . . *T. excavatum* Smith. Haiti and Jamaica.

13. Limiting keels of antennal scrobes strong, first diverging then angled and running parallel to one another, enclosing an area twice as long as broad. Vertex alutaceous, finely and not very closely punctured. Prepectus with a ventral keel. Pleural suture little developed. First two abdominal segments strongly contracted at apex . . . . 14.

—. Limiting keels of antennal scrobes enclosing an area which is at most as long as broad . . . . 15.

14. Dorsal area of propodeum with very dense pubescence, sides dull, striate. Ocelli separated by half their diameter from eyes *T. aureovestitum* Taschenberg. ♂♀.

—. Dorsal area of propodeum not densely pubescent, sides smooth and shining. Ocelli separated by one-quarter their diameter from eyes. *T. scrobiferum* sp. n. ♀.

15. Mesonotum alutaceous, dull, with rather sparse, but large punctures. Vertex finely coriaceous with sparse, fine punctures. Prepectus with no ventral keel. Angles of pronotal collar more or less bordered. Furrow of posterior surface of propodeum separated by half its length from orifice . . . . *T. alutaceum* sp. n.

—. Mesonotum shining, more or less punctured . . . . 16.

16. Very large, entirely black species, length 18 mm. Mesonotum closely punctured. Pleural suture only extending one-quarter of the way up the pleuron. Prepectus with a rudimentary dorsal keel and no ventral one. Ocelli separated by half their diameter from eyes . *T. gaucho* sp. n. ♀.

—. Smaller species or structure or colour different . . . . 17.

17. Vertex dull, alutaceous, unpunctured or with fine punctures which are not nearly confluent. Occiput raised behind each lateral ocellus and impressed between them. Supraantennal keel rather strong. Ocelli separated by one-quarter their diameter from eyes . . . . 18.

—. Vertex coarsely and confluently punctured, even if shallowly, or else shining . . . . 26.

18. Mesonotum rather strongly and closely punctured . (Cf. *T. nattereri* sp. n.).

—. Mesonotum sparsely and obsoletely punctured . . . . 19.

19. Prepectus with a ventral keel. Angles of pronotal collar moderately prominent . . . . 20.

—. Prepectus with no ventral keel . . . . 22.

20. Abdomen and legs largely testaceous. Pubescence bright brassy. Angles of propodeum with strong striae. Vertex with punctures as large as in *T. bogotense* sp. n. but separated by less than their diameter *T. xanthandrum* sp. n. ♂.

—. Abdomen and legs mainly black. Pubescence silvery. Angles of propodeum with weak, irregular striae . . . . 21.

21. Vertex with moderately large punctures, separated by more than their diameter. Proepisternal keel forming a sharp tooth at sides. Angles of pronotal collar very strongly bordered. Pleural suture well developed *T. bogotense* sp. n. ♀.

—. Vertex with very fine punctures, separated by their diameter or less. Proepisternal keel not forming teeth even at sides. Pronotal collar with angles not bordered. Pleural suture little developed *T. agamemnon* sp. n. ♂.

22. Pleural suture not developed. Large species with legs entirely pale . . 23.
—. Pleural suture extending at least one-third of the way up the pleuron . . 24.
23. Larger, length 15 mm. Ventral half of thorax and whole abdomen yellow. Angles of propodeum strongly striate. Proepisternal keel rounded . . . . *T. semiflavum* sp. n. ♀.
—. Smaller, length 13 mm. Thorax and abdomen mainly black. Angles of propodeum very obsoletely striate. Proepisternal keel sharp-edged, though not forming teeth . . . . *T. emdeni* sp. n. ♀.
24. Large species with legs and abdomen mainly orange. Dorsal keel of prepectus very short. First abdominal tergite very elongate. Proepisternal keel forming a tooth at sides only . . *T. laevifrons* Smith. ♀.
—. Smaller species with legs and abdomen mainly black. Proepisternal teeth moderately strong. Angles of pronotal collar bordered, not very prominent . . . . *T. nitidum* Smith (vars.).
—. Smaller species with legs and abdomen mainly black. First tergite not unusually elongate. Proepisternal keel forming strong teeth at sides and centre. Angles of pronotal collar very prominent, not bordered . . 25.
25. Limiting keels of antennal scrobes relatively strong. Posterior truncation of supraantennal keel longer than broad. Furrow of posterior surface of propodeum crossed by a keel above the one defining the keeled depression. Smaller species . . . . *T. vagulum* sp. n. ♂♀.
—. Limiting keels of antennal scrobes weak. Posterior truncation of supraantennal keel strong, subcircular. Furrow of posterior surface of propodeum with only a keeled depression. Larger species *T. vagum* Smith. ♀.
26. Prepectus with a ventral keel. Pleural suture usually little developed . 27.
—. Prepectus with no ventral keel. Pleural suture well-developed . . . 33.
27. Vertex posteriorly with coarse and not very close punctures, interstices shining. Mesonotum shining coarsely but not closely punctate. Mesopleuron very sparsely punctured. Ocelli separated by one-quarter their diameter from eyes. Pleural suture well developed . *T. alleni* sp. n. ♂
—. Vertex with subconfluent punctures, often subrugose. Pleural suture usually little developed. (*T. mutatum* which has the vertex most similar has ocelli separated by half their diameter from eyes.) . . . . . . 28.
28. Central tooth of clypeus much stronger than the two on each side of it. Sides and dorsal area of propodeum very weakly striate, not very closely punctured, shining. Angles of pronotal collar not bordered *T. fugax* Fabricius.
—. Clypeus if tridentate with the central tooth smaller than the others . . 29.
29. Abdominal sternites of female dull, closely punctured, of male with considerable scattered pubescence. Limiting keels of antennal scrobes weak. Angles of pronotal collar scarcely bordered. Dorsal surface of propodeum flat . . . . *T. triodon* sp. n. ♂♀.
—. Abdominal sternites bare and shining . . . . 30.
30. Dorsal surface of propodeum with a very distinctly impressed, cross-striate, central triangle, bordered by raised punctured areas. Posterior surface of propodeum with furrow to the orifice, crossed below by a strong keel above the one defining the keeled depression. Size rather small *T. optimum* sp. n. ♂♀.
—. Dorsal surface of propodeum scarcely depressed. Size larger . . . . 31.
31. Posterior surface of propodeum with furrow ending distinctly before the orifice and keeled depression. Sides shining, not closely punctate-striate. Pronotal collar with its angles not bordered *T. fugax* Fabricius var. *santamartae* var. n. ♂.
—. Posterior surface of propodeum with furrow extending to orifice, crossed by a few very weak striae, no clearly defined keeled depression. Sides dull,

closely punctate-striate. Angles of pronotal collar bordered. Pleural suture often extending half-way up the pleuron . . . . 32.

32. Dorsal area of propodeum dull, closely punctured, hardly striate. Mesonotal punctures stronger . . . . *T. mutatum* Kohl. ♂♀.

—. Dorsal area of propodeum somewhat shining, distinctly transversely striate. Mesonotal punctures weaker . . . . *T. transversistriatum* Strand. ♂♀.

33. Posterior end of supraantennal keel raised into two small approximated thorn-like tubercles. (This requires a high magnification to see.) Dorsal surface and sides of propodeum closely striate, the former not depressed. Ocelli separated by two-thirds their diameter from eyes. Male with hind trochanter ventrally raised into a lamella
T. orizabense sp. n. ♂♀.

—. Supraantennal keel not so formed. Ocelli nearer to eyes . . . . . . 34.

34. Dorsal surface of propodeum with a large depressed area which is coarsely striate, sides also more or less coarsely striate. Supraantennal keel moderately strong. Proepisternal keel forming a tooth at sides only . 35.

—. Dorsal area of propodeum with never so distinctly depressed an area which is never so coarsely striate. Sides never more than finely striate (except sometimes *T. mendozanum* sp. n.) . . . . 36.

35. Base of antennae, pronotum and legs (except base of coxae) red. Limiting keels of antennal scrobes strong but short. Clypeus with a slight apical emargination. Prepectus with dorsal keel extending half-way across
T. collinum Smith. ♀.

—. Striae of dorsal area of propodeum coarser. Antennae, pronotum and legs (mainly) black. Limiting keels of antennal scrobes enclosing a quadrate area. Clypeus thickened in centre of apex. Prepectal dorsal keel complete . . . . *T. obidense* sp n. ♂.

36. Supraantennal keel posteriorly subcircularly truncate. Sides and dorsal surface of propodeum rather strongly punctured. Proepisternal keel obsolete towards the centre, not forming teeth
T. rubrocinctum Packard. ♂.

—. Sides and dorsal surface of propodeum finely punctate or striate. Supraantennal keel only weakly and narrowly truncate. Proepisternal keel complete with at least one tooth . . . . 37.

37. Dorsal area of propodeum finely striate; sides punctate-striate. Prepectus with no dorsal keel . . . . *T. mendozanum* sp. n. ♂♀.

—. Sides and dorsal area of propodeum finely punctate, with at most very obsolescent striae, more shining. Prepectus with a more or less distinct dorsal keel. . . . . 38.

38. Size larger, length about 14 mm. Ocelli separated by one-third to two-thirds their diameter from eyes (usually more than half). Pubescence brassy, at least on pronotal collar, and face. Base of antennae pale. Limiting keels of antennal scrobes stronger . *T. aurifrons* Shuckard. ♂♀.

—. Ocelli separated by one-quarter to one-third their diameter from eyes. Pubescence often silvery. Antennae usually entirely dark, at most some of the segments pale beneath. Limiting keels of antennal scrobes weaker . . . . 39.

39. Size as in *T. aurifrons* Sm. Mesonotum much more closely and strongly punctured (separated by two diameters or less). Furrow of posterior surface of propodeum crossed by another distinct keel above the keeled depression. Prepectal keel complete. Wings and legs dark, pubescence silvery . . . . *T. majus* sp. n. ♀.

—. Size smaller, length 9–12 mm. (rarely as much as 13 mm.). Mesonotum more sparsely and finely punctured. Furrow of posterior surface of propodeum not crossed by a keel above the keeled depression. Dorsal keel of prepectus extending half-way across it . *T. nitidum* Smith. ♂♀.

KEY TO GROUP OF *T. FABRICATOR* SMITH.

1. Mesonotum punctured, if finely, then closely; often also alutaceous, rarely very shining.
(Lateral tubercles of pronotum usually obsolete; fore coxae of female never with strong bristles at apex.) . . . . 2.

—. Mesonotum and scutellum very shining, hardly perceptibly punctured . 23.

2. Mesonotum rather shining, very finely punctured. Dorsal margin of orifice on propodeum produced into a distinct projecting lobe.
(Ocelli separated by rather less than half their diameter from eyes. Limiting keels forming a straight transverse keel. Proepisternum with no keel, tubercle little prominent.) . . . . 3.

—. Mesonotum dull, alutaceous and closely and finely punctured. Orifice of propodeum with a projecting lobe. Limiting keels of antennal scrobes not developed. Hind trochanter sharply pale . *T. leucarthrum* sp. n. ♀.

—. Mesonotum either less shining (alutaceous) or more strongly punctured. Dorsal margin of orifice on propodeum not produced into a lobe . . 4.

3. Supraantennal keel not strong, on a slight prominence. Vertex with close, fine, flat-bottomed punctures. Antennal sockets separated by half their diameter from eyes . . . . *T. manni* sp. n. ♂♀.

—. Supraantennal keel rather strong, on a distinct prominence. Vertex coriaceous with sparse punctures. Antennal sockets separated by one-quarter their diameter . . . . *T. silvestre* sp. n. ♀.

4. Limiting keels of antennal scrobes not developed. (Sides of propodeum finely striate.) . . . . 5.

—. Limiting keels of antennal scrobes forming a straight or angulated, transverse keel (sometimes rather weak) . . . . 6.

5. Ocelli separated by half their diameter from eyes. Tubercle of proepisternum slightly raised. Supraantennal keel weak. Lateral tubercles of pronotum very strong. Only knees and tarsi, in part, pale
T. rugiceps Dalla Torre. ♂.

—. Ocelli separated by one-quarter their diameter from eyes. Coxae largely pale . . . . *T. fitzgeraldi* sp. n. ♂♀.

—. Ocelli separated by two-thirds their diameter from eyes. Tubercle of proepisternum very strongly raised. Supraantennal keel very strong. Lateral tubercles of pronotum obsolete. Femora and tibiae considerably pale marked . . . . *T. unguicorne* sp. n. ♂.

6. Limiting keels of antennal scrobes forming a straight transverse keel. Hind coxa of female ventrally simple or (*T. scutiferum*) with a very minute tubercle . . . . 7.

—. Limiting keels of antennal scrobes forming an angulated transverse keel (sometimes rather obtusely angulated). Hind coxa of female sometimes with a distinct ventral tubercle . . . . 13.

7. Pleural suture extending half-way up the pleuron.
(Pronotal collar with lateral angles and centre very prominent, lateral tubercles of pronotum rather strong. Tubercle of proepisternum forming a blunt point. Ocelli separated by half their diameter from eyes. Antennal sockets contiguous.) . . . . *T. cornigerum* Cameron. ♂♀.

—. Pleural suture not developed or (*T. maidli* sp. n.) very short, but then the centre of pronotal collar not prominent . . . . 8.

8. Horizontal space behind the buccal cavity broad; or, if rather narrow, proepisternal tubercle prominent and antennal sockets separated by less than one-third their diameter . . . . 9.

—. Horizontal space behind buccal cavity very narrow, almost obliterated.
(Antennal sockets separated by more than half their diameter. Pro-

episternal keel obsolete, tubercle not prominent. Ocelli separated by their diameter from eyes.) . . . . 12.

9. Pleural suture indicated ventrally. Length 9–10 mm. Dorsal surface of propodeum with irregular, largely longitudinal striae.
(Ocelli separated by half their diameter from eyes. Horizontal space very broad. Proepisternum with no keel, tubercle prominent.) . . . 10.

—. Pleural suture obsolete. Length 7·5 mm. Dorsal surface of propodeum with more regular striae which are diagonal at base and transverse at apex . . . . 11.

10. Mid femora clear red, fore femora largely red. Sides of propodeum distinctly, though weakly, striate; curved keel in front of hind coxa preceded by two or three others equally strong . . *T. maidli* sp. n. ♀.

—. Mid femora dark ventrally, fore femora largely black. Sides of propodeum with hardly distinguishable striae; no strong ones in front of keel curving up in front of hind coxae . . . . var. *bodkini* var. n. ♂♀.

11. Horizontal space behind the buccal cavity broad. Lateral angles and centre of pronotal collar not very prominent. Metanotum flat. Ocelli separated by three-quarters their diameter from eyes. Proepisternum with a distinct keel in front of prominent tubercle *T. scutiferum* Taschenberg. ♀.

—. Horizontal space narrow. Lateral angles and centre of pronotal collar prominent. Metanotum weakly impressed. Ocelli separated by half (♀) or one (♂) diameter from eyes. Proepisternal keel obsolete, tubercle prominent . . . . *T. frioense* sp. n. ♂♀.

12. Mesonotum slightly alutaceous, not very shining. Sides of propodeum more or less striate; dorsal area with more numerous and regular striae *T. asuncicola* Strand. ♂♀.

—. Mesonotum shining, not alutaceous. Sides of propodeum smooth and shining; dorsal area with less numerous and more regular striae var. *levius* var. n. ♀.

13. Ocelli separated from eyes by less than half their diameter.
(Proepisternal keel hardly developed, tubercle not prominent. Sides of propodeum with a keel curving up in front of hind coxae (except *T. trinidadense* sp. n.), otherwise smooth and shining.) . . . . 14.

—. Ocelli separated by half their diameter from eyes. Sides of propodeum with no keel in front of hind coxa . . . . *T. pachygaster* sp. n. ♂.

—. Ocelli separated by two-thirds their diameter or more from eyes . . . 18.

14. Vertex with very large punctures separated by about their diameter. abdomen largely red. Length 14 mm. . . . *T. posterorubrum* sp. n. ♀.

—. Vertex finely or obsoletely punctured. Abdomen less red. Size smaller . 15.

15. Mesopectal-metapleural suture crenulate. Apical margin of clypeus hardly sinuate. (Dorsal area of propodeum undefined, with numerous striae, diagonal at base, transverse at apex. Supraantennal keel fine and short, not on a prominence. Antennal sockets separated by one-third their diameter. Ocelli separated by rather less than half their diameter from eyes. Furrow on posterior surface of propodeum ending in a keeled depression bisected by a longitudinal keel.) . . . *T. crudele* sp. n. ♀.

—. Mesopectal-metapleural suture not crenulate. Apical margin of clypeus with a weak, bilobed projection . . . . 16.

16. Antennal sockets separated by one-third their diameter. Occipital keel centrally interrupted. Furrow on posterior surface of propodeum with a keeled depression which is bisected by a longitudinal keel. Lateral tubercles of pronotum distinct. Dorsal area of propodeum rather well defined . . . . *T. xenophon* sp. n. ♀.

—. Antennal sockets separated by two-thirds their diameter. Occipital keel complete. Furrow on posterior surface of propodeum with no keeled depression. Lateral tubercles of pronotum very weak. Dorsal area of propodeum hardly defined . . . . 17.

17. Supraantennal keel not prominent. Furrow of posterior surface of propodeum crossed by two or three weak keels, sides without a keel curving up in front of hind coxae . . . . *T. trinidadense* sp. n. ♀.

—\. Supraantennal keel prominent. Furrow of posterior surface of propodeum not crossed by keels, sides with a keel curving up in front of hind coxae *T. johnsoni* Fox. ♀.

18. Sides of propodeum distinctly striate, at least dorsally and posteriorly. (Proepisternal keel subobsolete. Ocelli separated by three-quarters their diameter from eyes) . . . . 19.

—\. Sides of propodeum smooth, unsculptured . . . . 20.

19. Legs black, except for knees and ventral surface of fore tibiae. Dorsal surface of propodeum strongly defined. Length 9 mm. *T. florale*, sp. n. ♀.

—\. Fore femora mostly and mid tibiae entirely pale. Dorsal area of propodeum scarcely defined. Length 6 mm. . . . . *T. dyeri* sp. n. ♂.

20. Body mainly testaceous-yellow, with brassy pubescence. Proepisternum simple. Hind coxa in female with a strong apical, ventral tubercle *T. mutilatum* sp. n. ♀

—\. Body mainly black, with silvery pubescence. Proepisternum with a strong tooth . . . . 21.

21. Anterior ocellus in a strong depression, posterior ones in a common depression. Mesonotum with a longitudinal elevation on each side of disc. *T. cameronii* Dalla Torre. ♂.

—\. Ocelli not in depressions. Mesonotum without elevations . . . . . 22.

22. Femora entirely yellow. Dorsal surface of propodeum with numerous, nearly obsolete, transverse striae . . . . *T. ornatipes* Fox. ♂.

—\. Femora black, except underside of anterior pair. Dorsal surface of propodeum with a longitudinal impression crossed by about 10 rather distinct striae . . . . *T. arroyense* sp. n. ♂.

23. Propodeum with no projection above the orifice. Vertex finely and closely punctured, shining (duller in *T. grenadense* sp. n.) . . . . 24.

—\. Propodeum with a distinct projection above the orifice. Vertex usually more or less wrinkled or rugose, especially in the male; in the female often densely alutaceous, never punctured.
(Pleural suture not developed. Proepisternum with a strong, lamelliform tooth. Lateral tubercles of pronotum forming strong bluntly triangular projection. Female fore coxa with strong bristles at apex; hind coxa with no ventral tubercle.) . . . . 29.

24. Pleural suture well developed. Ocelli separated by one-quarter their diameter from eyes. Dorsal area of propodeum well defined. Limiting keels of antennal scrobes forming an angulated transverse keel. (Hind coxa of female with a strong ventral tubercle.) *T. cinctellum*, sp. n. ♀.

—\. Pleural suture obsolete. Ocelli separated by two-thirds their diameter from eyes or more. Dorsal area of propodeum scarcely defined. Limiting keels of antennal scrobes forming a straight or slightly angulated (*T. nitidissimum* sp. n.) transverse keel . . . . 25.

25. Vertex alutaceous, especially anteriorly, dull (duller in male) with weak, fine punctures. (Proepisternal tubercle produced into a very prominent lamella in the male.) . . . . *T. grenadense* sp. n. ♂♀.

—\. Vertex shining, finely punctured . . . . 26.

26. Supraantennal keel moderately strong. Proepisternum with a very strong, lamelliform tubercle in male. Body entirely black *T. nitidissimum* sp. n. ♂♀.

—. Supraantennal keel not or hardly developed. Proepisternum with at most a small tubercle. Legs considerably pale . . . . 27.

27. Femora black. Horizontal space behind buccal cavity one and a half times as wide as fore basitarsus . . . . *T. urichi* sp. n. ♂.

—. Four anterior femora reddish. Horizontal space narrower than width of fore basitarsus . . . . 28.

28. Abdomen with only tergite 3 testaceous at sides basally. Mid femora entirely reddish. Posterior furrow of propodeum with a distinct keeled depression . . . . *T. rubrifemoratum* sp. n. ♀.

—. Abdomen with segments 2–3 entirely red. Mid femora with a dark posterior streak. Keeled depression hardly developed . var. *rubellum* var. n. ♀.

29. Base of antennae sharply yellow, contrasting with apical half . . . . 30.

—. Antennae unicolorous or nearly so, at most a few basal segments very indeterminately pale . . . . 31.

30. Abdomen largely reddish. Transverse keel above sockets acutely angled. Posterior surface of propodeum above with a deep, subcircular depression which is continued below only as a fine line, not crossed by any keels. Angles of posterior surface absolutely unsculptured.
(Vertex of female hardly alutaceous, distinctly wrinkled, the edges of the wrinkles rounded. Ocelli separated by half their diameter from eyes.)
T. rugifrons Smith. ♀.

—. Abdomen black with the three basal segments barred with yellow. Transverse keel above sockets obtuse, in female quite rounded. Posterior surface of propodeum with a continuous furrow crossed by 4–5 keels. Angles of posterior surface nearly unsculptured.
(Vertex of female strongly raised, depressed in centre, densely alutaceous, with a few punctures; ocelli separated by half their diameter from eyes. Vertex of male strongly shining, with strong rounded wrinkles and a deep central impression; ocelli separated by three-quarters their diameter from eyes.) . . . *T. balteatum* Cameron. ♂♀.

31. Transverse keel above the sockets very obtusely angled, almost rounded. Posterior surface of propodeum with furrow almost as in *T. rugifrons* but furrow stronger below.
(Vertex of female moderately alutaceous, somewhat shining with feeble wrinkles; ocelli separated by one-quarter their diameter from eyes. Vertex of male strongly shining, with strong, rounded-edged wrinkles; ocelli separated by nearly half their diameter from eyes.)
T. mazaruni sp. n. ♂♀.

—. Transverse keel above sockets sharply angled . . . . 32.

32. Males. (Ocelli separated by two-thirds their diameter from eyes.) . . 33.

—. Females. (Ocelli separated by one to two-thirds their diameter from eyes.) 34.

33. Wrinkles of vertex very strong but their edges rounded. Angles of posterior surface of propodeum with strong, regular, widely spaced striae. Dorsal surface with numerous strong transverse striae. Pubescence golden. Size larger . . . . *T. gounellei* sp. n.

—. Wrinkles of vertex less strong but almost sharp-edged. Angles of posterior surface of propodeum and dorsal surface with weaker, less numerous striae. Pubescence silvery. Size smaller . . . . *T. fabricator* Smith.

34. Vertex densely alutaceous, scarcely wrinkled. (Tarsi dark, more or less white-marked. Pubescence silvery.) . . . . . . *T. fabricator* Smith.

—. Vertex dull, weakly wrinkled. Species almost entirely black. (Pubescence silvery. Dorsal area of propodeum more convex than in *T. fabricator*.)
T. cocorite sp. n.

—. Vertex distinctly wrinkled, more or less shining, scarcely alutaceous . . 35.

35. Length about 12–13 mm. Legs, especially tarsi, largely testaceous. Pubescence golden. Wrinkles of vertex strong . . . *T. gounellei* sp. n.

—. Legs mainly dark. Pubescence silvery. Wrinkles of vertex weaker . 36.
36. Length about 9·5 mm. Wrinkles separated by subcircular depressions. (Species almost entirely dark.) . . . . *T. trigeminum* sp. n.
—. Length about 13 mm. Wrinkles separated by elongate depressions . . 37.
37. Abdomen entirely testaceous except for segment 1. Supraantennal keel stronger. Ocelli separated by one-third their diameter from eyes *T. moraballi* sp. n.
—. Apex of abdomen dark. Supraantennal keel weaker. Ocelli separated by two-thirds their diameter from eyes . . . . . var. *boliviense* var. n.

Key to known Males of group of T. fabricator *Smith.*

1. Antennae simple . . . . 2.
—. Antennae more or less modified; at least with the sixth segment somewhat thickened and excised beneath; segments 11 and 12 quadrate or broader 8.
2. Vertex with sinuate raised prominences. Mesonotum shining and almost impunctate (see no. 30 in previous key).
—. Vertex smooth, dull, finely coriaceous. Mesonotum dull, alutaceous . . 3.
3. Ocelli separated by one-quarter their diameter from eyes. Fore coxae pale *T. fitzgeraldi* sp. n.
—. Ocelli separated by at least half their diameter from eyes. Fore coxae dark 4.
4. Ocelli separated by half their diameter from eyes . . . . 5.
—. Ocelli separated by three-quarters their diameter from eyes or more. Fore and mid tibiae yellow-brown . . . . 6.
5. Fore and mid tibiae pale . . . . *T. manni* sp. n.
—. Fore and mid tibiae almost entirely black . . . . *T. rugiceps* Dalla Torre.
6. Antennal sockets separated by half their diameter. Striae of dorsal area of propodeum regular, posterior surface with little pubescence *T. asuncicola* Strand.
—. Antennal sockets contiguous. Striae of dorsal area of propodeum irregular 7.
7. Posterior surface of propodeum with conspicuous silvery pubescence *T. frioense* sp. n.
—. Posterior surface of propodeum with sparse pubescence . . *T. maidli* sp. n.
8. Antennal segments 3–4 and base of 5 with a fringe of white pubescence on outer side; segment 6 strongly thickened and excised at base; segment 13 longer than the four preceding together . . *T. cameronii* Dalla Torre.
—. Antennal segments 3–5 unfringed; segment 13 at most as long as the four preceding segments together . . . . 9.
9. Antennal segment 3 half as long as 4; 10 swollen at apex beneath and contracted at base . . . . 10.
—. Antennal segment 3 about as long as 4 or longer . . . . 11.
10. Antennal segment 4 twice as long as broad; 6 strongly swollen at middle and at apex (where it is produced beneath 7), emarginate beneath *T. arroyense* sp. n.
—. Antennal segment 4 one and a half times as long as broad; 6 swollen at apex, 7 swollen at base, together forming a blunt projection *T. ornatipes* Fox.
11. Antennal segment 10 simple . . . . 12.
—. Antennal segment 10 thickened beneath . . . . 13.
12. Antennal segment 3 much longer than 4; segments 5 and 6 jointly excavated at their junction . . . . *T. urichi* sp. n.
—. Antennal segment 3 about as long as 4; segment 6 thickened and excised beneath . . . . *T. grenadense* sp. n.
13. Antennal segment 10 produced into a long, ventral hook; 13 shorter than the two preceding segments together . . . . . *T. unguicorne* sp. n.
—. Antennal segment 10 only thickened at apex . . . . 14.

14. Antennal segments 5–7 simple; 9 and 10 keeled beneath; 11 and 12 longer than broad; 13 as long as the two preceding segments; 3 twice as long as 4 . . . . *T. cornigerum* Cameron.

—. One of antennal segments 5–7 modified beneath . . . . 15.

15. Antennal segments 6 and 7 each with a small tubercle beneath, together bounding a shallow emargination; 11 and 12 transverse; 13 as long as the three preceding segments; 3 about as long as 4 . *T. nitidissimum* sp. n.

—. Antennal segment 6 emarginate beneath, apically thickened and produced under 7 which is simple; 9 and 10 keeled beneath; 9 emarginate beneath; 11 and 12 transverse; 13 as long as the three preceding segments; 3 distinctly longer than 4 . . . . *T. dyeri* sp. n.

—. Antennal segments 5, 6 and 7 each emarginate beneath; 11–12 quadrate, 13 as long as the four preceding segments; 3 as long as 4 *T. pachygaster* sp. n.

KEY TO GROUP OF *T. MARGINATUM* CAMERON.

1. Antennal sockets separated by less than half their diameter; keel of vertex not bifurcating below or enclosing an area above . . . . 2.

—. Antennal sockets separated by one and a half times their diameter; keel of vertex bifurcating below . . . . 4.

2. Dorsal area of propodeum with a strong, crenulate, transverse furrow at its base. Ocelli separated by one-third their diameter from eyes. Mesonotum finely and closely punctured, shining. Mandibles with a tooth on upper margin . . . . *T. pentheri* sp. n. ♀.

—. Dorsal area of propodeum without a transverse, basal furrow. Mesonotum alutaceous, duller (except *T. bellardi* which is the only species of the group with the clypeus higher than broad). Mandibles simple, except *T. bellardi* which has a minute tooth . . . . 3.

3. Ocelli separated by half their diameter from eyes. Dorsal area of propodeum feebly defined, surface not very regularly striate, somewhat clathrate; whole surface of propodeum dull . . *T. winthemi* sp. n. ♂.

—. Ocelli separated by less than one-quarter their diameter from eyes. Dorsal area of propodeum rather well defined, regularly and finely cross-striate; sides shining, feebly striate . . . . *T. stieglmayri* sp. n. ♀.

—. Ocelli separated by one-quarter their diameter from eyes. Dorsal area of propodeum well defined, dull, very feebly cross-striate, sides coarsely alutaceous . . . . *T. bellardi* sp. n. ♂.

4. Mesopleuron and mesonotum shining, not alutaceous. Propodeum with dorsal area striate only across the central impression, sides smooth and shining . . . . 5.

—. Mesopleuron and mesonotum closely and finely punctured, alutaceous, dull. (*T. shannoni* which is somewhat intermediate, has the dorsal area of the propodeum striate.) . . . . 6.

5. Ocelli separated by one-quarter their diameter from eyes. Vertex outside the area with very large, coarse punctures. Angles of propodeum smooth . . . . *T. punctivertex* sp.n. ♀.

—. Ocelli separated by half their diameter from eyes. Vertex finely coriaceous, punctures subobsolete. Angles of propodeum more or less striate. The only species of the group with lateral tubercles of pronotum sharp-edged . . . . *T. marginatum* Cameron. ♂♀.

6. Antennae considerably, fore and mid tibiae entirely, pale. Anterior branches of vertical keel (below antennae) nearly twice as long as single keel between the antennae; posterior branches twice angled and meeting on the vertex. Ocelli separated by hardly more than one-third their diameter from eyes. Horizontal space behind buccal cavity not very narrow . . . . *T. excellens* Strand. ♀.

—. Antennae, fore and mid tibiae considerably pale. Anterior branches of vertical keel as long as single keel; posterior branches distinctly meeting in a curve. Ocelli separated by one-third their diameter from eyes. Horizontal space behind buccal cavity very narrow *T. shannoni* sp. n. ♂.

—. Entirely black species. Ocelli separated by half their diameter or more from eyes . . . . 7.

7. Ocelli separated by their diameter from eyes. Third antennal segment only a little shorter than the fourth and fifth together. Fourth rather less than twice as long as broad . . . . *T. peltopsis* Kohl. ♀.

—. Ocelli separated by two-thirds or less their diameter from eyes. Third antennal segment much shorter than the fourth and fifth together . . 8.

8. Ocelli separated by about half their diameter from eyes. Vertical keel becoming effaced near upper limit of eye-emargination, very indefinite above this point and scarcely meeting . . . . *T. sulcatoides* sp. n. ♂.

—. Ocelli separated by two-thirds their diameter from eyes. Vertical keel strong to where the arms meet below median ocellus *T. segregatum* sp. n. ♂♀.

KEY TO GROUP OF *T. RUFIDENS* CAMERON.

1. Vertex finely and closely punctured, somewhat shining. Mesonotum more strongly punctured, more shining. Ocelli separated by two-thirds their diameter from eyes . . . . *T. capitale* sp. n. ♂♀.

—. Vertex coriaceous, not punctured, quite dull. Mesonotum with hardly traceable punctures, duller. Ocelli separated by half their diameter or less from eyes . . . . 2.

2. Limiting keels of antennal scrobes extending back to a point level with mid point of eye-emargination. Thickened apex of clypeus truncate in an area which is higher than broad. Male with antennal segments 3–5 distinctly longer than broad, 10 and 11 jointly excavate beneath *T. rufidens* Cameron. ♂♀.

—. Limiting keels of antennal scrobes rather shorter, extending back only to a point level with ventral limit of eye-emargination . . . . 3.

3. Eyes below antennae about half the distance apart that they are on occiput. Female clypeus with thickened apex truncate in an area nearly twice as broad as high. Male antennae with segments 3–5 quadrate, 3 not as long as 2, 7–10 keeled beneath, 11 thickened beneath, projecting under 12 *T. duckei* sp. n. ♂♀.

—. Eyes below antennae about two-thirds as far apart as they are on occiput. Female clypeus as in *T. rufidens* Cam. Male antennae with segments 3–5 a little longer, 3 as long as 2, 8–11 keeled beneath, 11 hardly thickened beneath . . . . *T. barberi* sp. n. ♂♀.

KEY TO GROUP OF *T. FIGULUS* LINNAEUS.

1. Mesonotum shining. (Propodeum with a projection above the orifice or else the dorsal surface of propodeum is smooth and shining, unsculptured, except for central impression. Female hind coxa with at least a small ventral tubercle.) . . . . 2.

—. Mesonotum closely punctured, more or less alutaceous and dull (most shining in *T. nigrellum*) . . . . 3.

2. No projection above orifice of propodeum. Propodeum dorsally smooth except for central impression. Mesonotum unpunctured *T. nitidissimum* sp. n. ♀. (See group of *T. fabricator* Sm.).

—. A distinct projection above orifice of propodeum. Dorsal area well defined, with striae at base and across central impression. Mesonotum with numerous fine punctures . . . . *T. sanctum* sp. n. ♂♀.

3. Pleural suture well developed. Limiting keels of antennal scrobes forming a bisinuate, nearly straight, transverse keel. Hind coxa of female with a ventral tubercle . . . . *T. staudingeri* sp. n. ♀.

—. Pleural suture not developed . . . . 4.

4. Dorsal area of propodeum well defined . . . . 5.

—. Dorsal area of propodeum not or very feebly defined . . . . 8.

5. Small species, length 7 mm. Mesosternum finely and closely punctured, alutaceous. Eyes at nearest point separated by no more than distance between outer edges of antennal sockets. Central third of clypeus produced into a lobe which is emarginate in female and simple in male. Sides of propodeum weakly striate, smooth and shining in anterior lower third. Female hind coxa simple . . . *T. caldesianum* sp. n. ♂♀.

—. Mesosternum with large punctures . . . . 6.

6. Medium-sized species, length 9 mm. Mesothorax densely alutaceous, dull. Apex of clypeus transversely impressed, then somewhat upturned, central half produced into a trapezoidal lobe. Sides of propodeum closely striate, with scattered punctures. Female hind coxa with tubercle . . . . 7.

—. Small species, length 6·5 mm. Mesothorax rather weakly alutaceous, moderately shining. Central fifth of clypeus produced into a small lobe. Sides of propodeum closely striate. Female hind coxa simple *T. nigrellum* Rohwer. ♀.

7. Vertex and mesonotum coriaceous with practically no punctures. Limiting keels of antennal scrobes nearly straight. Ocelli separated by two-thirds their diameter from eyes . . . . *T. ecuadorium* sp. n. ♂♀.

—. Vertex and mesonotum coriaceous with sparse shallow punctures in addition. Limiting keels sharply angled. Ocelli separated by one-third their diameter from eyes . . . . var. *meridionale* var. n. ♀.

8. Horizontal space behind buccal cavity very narrow, as wide as apical segment of maxillary palpi. Limiting keels of antennal scrobes not developed, supraantennal keel nearly obsolete. Mesopleuron unpunctured, faintly alutaceous, slightly shining. Dorsal area of propodeum flat, irregularly transversely striate. Female hind coxa simple *T. nigrispinis* Cameron. ♀.

—. Horizontal space behind buccal cavity at least twice as broad as apical segment of maxillary palpi. Dorsal area of propodeum irregularly striate or with longitudinal striae. Female hind coxa ventrally with a dull pubescent patch . . . . 9.

9. Large species, length 12·5 mm. Sides of dorsal surface of propodeum with regular transverse striae, central impression with transverse striae. Eyes equidistant above and below antennae . . . *T. ordinarium* sp. n. ♀.

—. Small species, length 7–9 mm. Dorsal area of propodeum with at most rather irregular striae. Eyes distinctly closer at clypeus than on occiput (less so in *T. frigidum* Sm.) . . . . 10.

10. Supraantennal keel strong, on a strong prominence . . . . 11.

—. Supraantennal keel weak, on a slight prominence . . . . 13.

11. Dorsal surface of propodeum irregularly clathrate, with no central impression. First tergite short, two and a half times as wide at apex as at base, as long as hind femur and trochanter together. Second tergite a little longer than wide at apex. Lateral tubercle of pronotum moderately strong . . . . *T. plesium* Rohwer. ♂♀.

—. Dorsal area of propodeum laterally with more or less distinct longitudinal striae and with a central furrow. Lateral tubercles of pronotum weaker. First abdominal tergite longer and narrower . . . . 12.

12. First abdominal tergite parallel-sided for more than two-thirds of its length, then suddenly widening . . . . *T. apicale* Fox. ♀.

—. First tergite broader, its sides slightly divergent even from base *T. bidentatum* Fox. ♀.

13. Dorsal area of propodeum with a central impression. Mesosternum distinctly shining. First abdominal tergite longer and narrower, second more than twice as long as apical width . *T. morrisoni* sp. n. ♀.

—. Dorsal area of propodeum without central impression. Mesosternum dull. First tergite shorter and broader, second less than one and a half times as long as apical width . . . . *T. frigidum* Smith. ♂♀.

GROUP OF *T. ALBITARSE* F.

Thirteenth antennal segment strongly lengthened in the male. Antennal sockets separated by their diameter or nearly. Limiting keels of antennal scrobes little developed, when present parallel to one another. Supraantennal keel weak. Clypeus in both sexes with only very scattered outstanding hairs. In male often with an outstanding lamella, in female the least width between the eyes below is less than the height of the clypeus. Mandibles simple. Occipital keels incomplete, no horizontal space behind the buccal cavity. Lateral tubercles of pronotum elongate, not prominent, usually not sharp-edged. Angles of pronotal collar not bordered. Proepisternal keel not or scarcely developed. Prepectus not crossed by any keels or furrows. Pleural suture very short or absent. Transverse furrow in front of the mid coxae strong, more or less distinctly crenate. Metapleural keel nearly straight, area defined. Lateral lobes of the postnotum black, not at all raised into a lamella or (*T. barticense*) into a very feeble one. Furrow joining depressions in metapleural-propodeal suture weak, not crenate. Dorsal margin of orifice of propodeum broad and flat, or somewhat sloping in towards the orifice, which is about twice as broad as high. Fore coxae in female with strong apical bristles, quite distinct from the general pubescence. Fore coxae with a weak dorsal keel, ventral keel diagonal, usually weak, stronger in the sub-group of *T. aestivale* sp. n. Fore-wings with costa not produced beyond the radial cell, last section of M_{1+2} not more than $1\frac{1}{2}$ times the penultimate; M_{3+4} and im_1 set at an angle of 110–135°. Two groups of hamuli on hind-wings consisting of 6–12 hooks each, the groups separated by less than the length of the apical group. Abdominal sternites bare, except for a little pubescence round the base of the latero-apical bristles, which are 3 (more rarely 2) in number on each side of sternites 2–5. Male with first sternite often modified, eighth sternite basally with its dorsal surface projecting anteriorly to the ventral, apically produced into two long prongs. Male genitalia with stipes and squama completely fused, very long and narrow; volsellae of the two sides fused into a central lobe with a bluntly rounded, or very slightly emarginate apex; no basal or basi-lateral lobe to volsella; sagittae very long and narrow, apical structure varying in the three subgroups; cardo forming a very narrow ring with a truncate apex.

Large, black species, apex of hind basitarsus and whole of tarsal segments 2–4 white (5 also sometimes white). Wings more or less darkened.

Subgroup of *T. albitarse* F. confined to N. America; the other subgroups Neotropical, with a few species occurring in temperate regions of the extreme South.

The three following species which I have not been able to examine appear to be allied to *T. aestivale* sp. n. An examination of the types would almost certainly lead to the replacement of some of my names.

T. laeve Fox (1897, p. 384), Brazil, Maruru and Santarem.

T. columbianum Saussure (1867, p. 80), Colombia, Caracas.

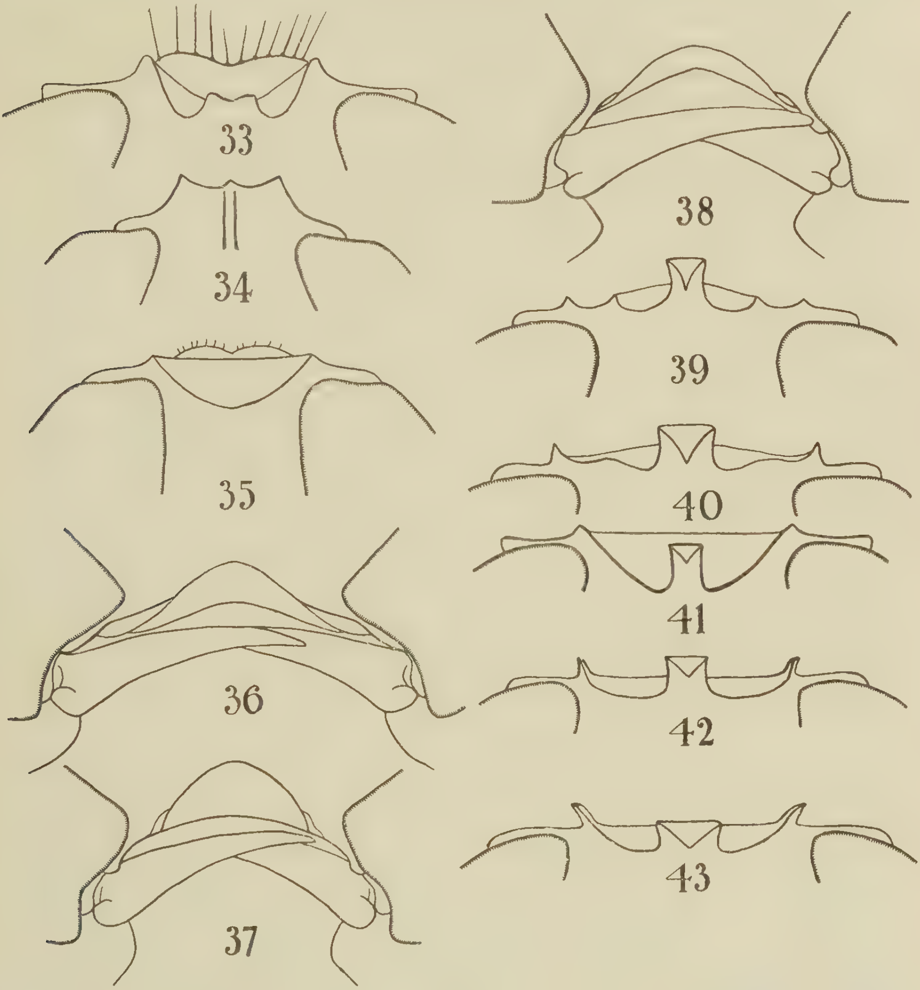
T. niveitarse Saussure (1867, p. 81), Brazil.

T. gandarai Rohwer (1912, p. 476), Mexico. I have included this species in the key.

T. palliditarse Saussure (1867).

(*T. rostratum* Taschenberg (1875); *T. leucotrichium* Rohwer (1912); *T. albitarse* auctt. in part).

Male. Black, apical half of hind basitarsus, segments 2–4 white; 5 normally black, sometimes brownish or with the proximal half white. All pubescence white. Wings evenly dark brown with violet reflections. Mandibles reddish, yellower at base. Length 20 mm.



Figs. 33–43.—(33) Antero-dorsal view of clypeus of *T. schnusei* sp. n., male. (34) The same of *T. fuscipenne* F. (*nec* auctt.), male. (35) The same of *T. poultoni* sp. n., male. (36) Antero-ventral view of apex of clypeus in *T. poultoni* sp. n., male. (37) The same in *T. busckii* sp. n., male. (38) The same in *T. barticense* sp. n., male. (39) Antero-dorsal view of clypeus of *T. mexicanum* (Sauss.) Rohw., male. (40) The same of *T. melanoleucum* sp. n., male. (41) The same of *T. buchwaldi* sp. n., male. (42) The same of *T. palliditarse* Sauss., male. (43) The same of *T. palliditarse* Sauss., variety (Brazil, Hausa Colonia), male.

Occiput sparsely and finely punctured, somewhat alutaceous, little shining. Eyes a little closer together at clypeus than on occiput where separated by a distance equal to

2 + 3 of antennae. Ocelli separated by rather more than their diameter from eyes, by about diameter from one another. Vertex dull, alutaceous, with very close large shallow punctures, centrally impressed longitudinally. Supraantennal keel represented by a minute tooth. Limiting keels of antennal scrobes absent. Antennal sockets separated by their diameter. Antennae with scape twice as long as broad in middle, 3 six times as long as broad, a little longer than 4 + 5, 4 a very little shorter than 5, 5 twice as long as broad, 7 and 8 quadrate, 9–11 transverse, 13 as long as 9 + 10 + 11 + 12, five times as long as broad. Clypeus (figs. 42 and 43) a little produced, with obtuse central keel, apex laterally with broad, truncate tooth on each side, this separated from nearest point of eye by the length of antennal segment 6. Between these teeth the apex broadly and shallowly emarginate, with a strong outstanding process above. The process which is a prolongation of central keel, is truncate at apex, little longer than broad. Beneath it clypeus seen from in front or beneath is truncate so that over a large crescentic area its margin is thickened, this area about four times as wide as high in centre. Occipital keels incomplete, no horizontal space behind the buccal cavity. Tempora beneath shining, finely and sparsely punctured. Stipes of maxillae smooth and shining, with sparse punctures and a strong pointed tubercle at base. Proepisternal keel quite rounded, only just distinguishable. Pronotal collar with angles completely rounded. Prepectus like the mesopectus moderately finely and closely punctured. Mesosternum finely and sparsely punctured, nearly bare. Distance between points of posterior mesosternal lobes fully three times their length. Mesonotum closely and moderately strongly punctured with a longitudinal area on each side raised, more shining and very sparsely punctured. Scutellum flat, sparsely and finely punctured. Metanotum flat, finely and sparsely punctured, lateral lobes appressed, striate, hairy, depressions large and shallow, filled with not very dense hairs. Area beneath metapleural keel, three times as long as broad. Metasternum pentagonal, one and a half times as long as broad, posterior emargination a very broad flat-bottomed U. Propodeum with dorsal surface flat, finely and not very closely punctured, sides finely and closely punctured, posterior surface with deep, moderately narrow furrow to orifice, no keeled depression, angles with strong keels, together enclosing quadrate area, angles right up to dorsal surface strongly and rather irregularly striate. Dorsal keel of mid coxae weak, not quite on outer edge. Hind coxae with an obsolescent inner dorsal keel on basal half. Hind femora with ventral lamella, including nearly one-half its length, rising scarcely more abruptly proximally than it does distally, lamella about five times as long as high, underside of femur with dense white hairs, about as long as lamella is high, denser just anteriorly to lamella. Mid femora considerably thickened with dense white hairs on distal two-thirds posteriorly. Anterior femora with a short, moderately dense, white fringe posteriorly. Hind tibiae with dorsal edge hardly angular, with numerous irregular spines. Forewings with last section of M_{1+2} about one and a half times as long as the penultimate, submarginal cell four times as long as broad in middle. First abdominal tergite with no furrow, spiracles somewhat projecting, spiracular area nearly twice as long as broad, basal apophyses very strongly and angularly produced, apophysal area three times as broad as long. Beyond apophyses tergite about as broad as length of hind trochanters, twice as broad at apical margin, second tergite about half length of first, as broad apically as long, first and second tergites moderately contracted distally, second and third quite strongly proximally, first to third with a distinctly marked off apical ring. First and second quite unpunctured, third and fourth closely but very microscopically punctured. Seventh tergite not keeled. Sternites with 0, 4, 6, 6, 6 bristles respectively, sternites otherwise bare except for small hair-patches round bases of bristles. First sternite with a thickening at base from which projects a long hook, in profile little curved, emargination beneath it reaching anteriorly to a point nearer end of apophyses than spiracle; thickening preceding hook a little longer than broad, hook about one and a half times

longer, ventral surface of hook finely punctured. Beyond the hook the sternite has a longitudinal, parallel-sided impression, including the median half of its width. Second sternite depressed at base, raised and rounded at apex, unpunctured except for about twelve small points forming two circular patches on each side of base. Third and fourth sternites depressed across the centre, base raised and rounded dull, apex less raised; two patches of fine punctures on each side of base. Dorsal surface of eighth sternite (fig. 30) produced anteriorly beyond ventral surface in a trapezoidal, emarginate lobe. Genitalia (figs. 27 and 28) with stipes-squama simple at base, hairs along inner margin almost interrupted in centre, volsellae forming together an obtusely rounded lobe, more or less emarginate distally. Sagitta simple at apex.

Female differs as follows :—Mandibles sometimes dark; average size a little larger. Antennae a little clavate, segment 12 as long as 11. Clypeus distinctly produced, distinctly keeled, especially towards the polished apical margin, which is somewhat truncate in centre and the truncation very shallowly emarginate. Stipes of maxillae hairy, the hairs denser towards the base but no basal tubercle. Mesosternal lobes much closer together. Metasternal emargination V-shaped. Mid and hind femora simple. Hind tibiae rounded with no strong bristles. Apophyses of first abdominal tergite weaker and scarcely angular. Sixth tergite keeled throughout its length. Sternites all simple.

This description of the female applies, except for a few small details, to all members of this sex belonging to the subgroup of *T. palliditarse* Sauss.

I have examined numerous males from Panama, Trinidad, Venezuela, Colombia, British Guiana, French Guiana, Brazil, Bolivia, Peru (Amazonian side), Paraguay. I have further seen females from California, Mexico, Dutch Guiana, Grand Cayman (B.W.I.) and Argentina in addition. The first two countries are out of the normal range of the species, which is the common mud-dauber of the neo-tropical region. Possibly there has been some confusion in the labelling. I have not examined the actual type of *T. palliditarse*, but I have seen a female from Saussure's collection. Saussure did not in any case designate a single specimen as type and as the females of the subgroups are not as a rule distinguishable, the synonymy is largely a matter of speculation.

I have seen the type of *T. rostratum* Taschbg. (Brazil, Parana), and it is evident from the description and from material received from the U.S. Nat. Mus. that *T. leucotrichium* Rohw. is the same species. In the older literature records from the neotropical region of *T. albitarse* probably mostly refer to the present species.

One male, Brazil, Hausa Colonia (B.) is structurally a little different from the normal form. The process of the clypeus (fig. 43) is one and a half times broader than long, separated from the lateral teeth by hardly more than its apical width (in *palliditarse* by fully two and a half times its apical width), lateral teeth larger and more projecting, area beneath process 5–6 times broader than high. L. 18 mm.

One female, British Guiana, Essequibo, Moraballi Creek, 1 Nov. '29, 5354 O.U.Exped. Brit. Guiana, " on leaf on trail " (L.), is structurally rather distinct but cannot as yet be associated with any male. Peculiar features are the black mandibles, the dark brown fifth segment of the hind tarsi, the unusually dark hind-wings; ocelli separated by no more than their diameter from the eyes, strong inner dorsal keel to hind coxae. L. 18 mm.

T. buchwaldi sp. n.

Male. Similar to *T. palliditarse* Sauss., but :—Dorsal margin of the hind-wings nearly hyaline; length 16 mm.

Antennae with 8–10 quadrate, 11 transverse. Clypeus (fig. 41) with the process twice as long as broad, area beneath it one and a half times as broad as high. Distance between points of posterior mesosternal lobes not quite three times their length. Mesonotum rather more finely punctured with the more sparsely punctured areas hardly recognisable. Propodeum with the area between the keels of the angles rather longer than broad, striae of angles weaker. Lamella of hind femora sinking more abruptly distally, mid femora less thickened. Emargination beneath hook of first abdominal sternite hardly reaching so far anteriorly as the spiracles, thickening preceding hook about two and a half times as long as broad, about twice as long as hook, sides of central depression beyond the hook at first somewhat convergent, then posteriorly divergent. Base of second sternite hardly depressed.

Female. Differs from *T. palliditarse* Sauss. only in the structure of the clypeus. Clypeus much more broadly truncate, truncation from rather more than once to fully twice as long as distance from one angle of truncation to upper mandibular condyle. In *T. palliditarse* the truncation is distinctly shorter than this distance. In *T. buchwaldi* the clypeus is less produced and the labrum therefore is more exposed; in front view, the apex of the clypeus is a little thickened, forming a narrow crescentic area.

Type. ♂, Guayaquil, Ecuador, Buchwald (V.). Allotype. ♀, above Bucay, Ecuador (*F. X. Williams*) (W.). Paratypes. *Ecuador:* 6 ♂♂, Guayaquil—F. W. Goding coll., Mrs. E. W. Rorer coll. and two with no further data (W.) and two similar males (P.). *Peru:* 3 ♂♂, Dept. Piura, 25 Feb. '11, no. 1117, bred 1 March '11 (*C. H. T. Townsend*) (W.); ♀, Tumber (P.); 2 ♀♀ and 5 ♂♂ with no further data (P.).

T. melanoleucum sp. n.

Male. Similar to *T. palliditarse* Sauss., but:—Baso-dorsal margin of hind-wings paler. Length 21 mm.

Vertex a little more rugosely punctured. Ocelli separated by one and a half times their diameter from eyes, by distinctly more than they are from one another. Clypeus (fig. 40) with the process almost angular, broad and large, one and a half times broader than long, separated from lateral-apical tooth by a little less than one and a half times its apical width. Area beneath process with a flat part immediately beneath process and a narrow lateral arm, set at a different level, connecting it with the lateral tooth, the flat area twice as wide as high. Proepisternal keel a little stronger. Metasternum more semicircular, twice as broad as long. First abdominal tergite with a dorsal furrow to spiracles, tergite nearly three times as wide distally as it is just after apophyses, second tergite about one and a half times broader distally than long. Hook of first sternite strongly curved, about as long as basal thickening preceding it.

Type. ♂, Brazil, Espirito Santo, coll. Fruhstorfer (B.).

T. bryanti sp. n.

Male. Similar to *T. palliditarse* Sauss., but:—Hind tarsi with fifth segment brown, basal quarter white. Wings without reflections, base of hind-wings paler. Length 15·5 mm.

Occiput behind ocelli distinctly less raised, more shining. Ocelli separated by one and two-thirds their diameter from eyes, by distinctly more than distance from one another. Limiting keels of antennal scrobes developed, subparallel, as long as diameter of sockets. Process of clypeus quite rounded, a little broader than long, area beneath it at least six times as wide as high. Distance between points of posterior mesosternal lobes only two and a half times their length. Metasternum as long as broad. Area beneath metapleural keel about four times as long as broad. Dorsal surface of propodeum with a faint depression. Keels of angles enclosing an area rather broader than high, angles less strongly striate. Hind tibiae with fewer spines. Hind femora with lamella including distinctly less than half its length, rising symmetrically both proximally and distally, about three and a half times as broad as high. Abdomen with a furrow for nearly half the length of first tergite. Hook of first sternite quite straight, emargination beneath hook reaches as far anteriorly as spiracles.

Type. ♂, Argentina, Riv. San Javier, Santa Fe, Estancion la Noria, 30 Dec. '11 (*G. E. Bryant*) (L.). Paratypes. ♂, with the same data, but 15 Jan. '12 (L.); ♂, Brazil, Rio Grande (L.).

T. mexicanum (Saussure) Rohwer (1912).

T. albitarse var. *mexicanum* Saussure (1867) nec *T. mexicanum* Sauss.

Male. Similar to *T. palliditarse* Sauss., but :—Fifth segment of hind tarsi white. All pubescence brownish except on lower half of face. Length 20 mm.

Occiput behind ocelli distinctly more shining. Eyes hardly closer below than above. Ocelli separated by from one to one and a half times their diameter from eyes. Antennae with 7–8 a little longer than broad, 13 four times as long as broad. Lateral-apical tooth of clypeus (fig. 39) separated from eyes by a distance as long as segment 8 of antennae. Process usually about quadrate, but somewhat variable, the area beneath it only twice as wide as high, defined laterally by strong moderately pointed teeth. Tempora beneath hardly punctured. Proepisternal keel not developed. Mesonotum considerably more finely and sparsely punctured, unpunctured areas hardly distinguishable. Scutellum hardly punctured. Metasternum one and three-quarters times as long as broad. Lamella of hind femora including only one-third of their length, higher and more abrupt, three times as broad as long. First abdominal tergite with spiracular area fully twice as long as broad, apophysal area two and a half times as broad as long. Hook of first sternite more curved at apex, emargination beneath the hook not nearly reaching back even to spiracles; thickening preceding hook three times as long as broad, about twice as long as hook; sides of depression beyond hook converging inwards in a gentle curve and suddenly curving out again quite near distal extremity of sternite.

Female. Differs from *T. palliditarse* Sauss. principally in the black pubescence. Mandibles usually reddish with their base yellower, rarely with the base darker. Fifth segment of hind tarsi brown with a small basal area whitish, rarely the basal half or even the whole segment white. Size on the average rather larger than in *T. palliditarse.*

I have examined 65 males and 96 females of this species, the bulk of the specimens having been captured in Mexico. It would serve no useful purpose to give all the records in full. The species is common throughout Mexico, right up to Yucatan and down to the south. It is further found in all the states of Central America down to Panama.

One male—Guatemala, Zapote (*G. C. Champion*) (B.C.A.)—has the clypeal process unusually broad, twice as broad as long, but owing to variation in this character it is impossible to define a variety.

A female—Venezuela, Cauca, Villa Elvira (B.)—from outside the normal range of the species differs in a number of particulars but is possibly not distinct. The mandibles are dark. The clypeus is scarcely keeled, the ocelli are separated by about their diameter from eyes; hind coxae with a strong inner dorsal keel on proximal half; fifth segment of hind tarsi white; length 14 mm. This agrees better with the members of the subgroup of *T. fuscipenne* F. but the pubescence is black, which is not the case in any other species of that section.

T. schnusei sp. n.

Male. Similar to *T. palliditarse* Sauss., but differs as follows :—Fifth segment of hind tarsi white; mandibles black. Length 19 mm.

Clypeus (fig. 33) strongly convex almost to antennal sockets, obtusely keeled, ending in a broad outstanding process whose apex is subangularly emarginate, central half of apical margin of clypeus deeply and roundly emarginate, emargination defined at sides by broad triangular teeth, beneath the outstanding process a narrow crescentic flat area. The bilobed labrum strongly exposed. Distance between the points of the posterior lobes of the mesosternum two and a half times their length. Lamella of hind femur only about one-third its length, four times as long as high. Spiracular area of first abdominal tergite four times as long as broad, first tergite after apophyses hardly broader than half the length of the hind trochanters, four times as broad at apex. First sternite with merely a hump including half its length, smooth and shining with a few hairs: beyond the hump the sternite has an oval impression. Second sternite strongly depressed at base, strongly raised at apex, apical prominence defined posteriorly by a strong bisinuate keel, which approaches nearer to posterior margin of sternite in centre than at sides. Third strongly depressed just after base, rather strongly raised at each side of apex. Fourth a little depressed at base. Genitalia with the sagittae strongly swollen at apex.

Type. ♂, Peru, 10 Nov. '02 (*W. Schnuse*) (D.)

T. albitarse Fabricius (1804).

(*T. politum* Say (1837)).

Male. Black, fore femora reddish at base externally; apical half of hind basitarsus and all remaining segments white. All pubescence black. Wings evenly dark brown. Mandibles piceous at apex. Length 19 mm.

Occiput behind ocelli very shining, not at all alutaceous. Eyes a little closer together at clypeus than on occiput where separated by a distance equal to 3 + 4 of antennae. Ocelli separated by nearly twice their diameter from eyes, by nearly one and two-thirds their diameter from one another. Vertex dull alutaceous, very closely, finely, and evenly punctured, punctures separated by less than their diameter, no longitudinal impressed line. Supraantennal keel on a slight prominence and in the form of a fine keel not truncate behind. Limiting keels of antennal scrobes absent. Antennal sockets separated by their diameter. Antennae with the scape nearly twice as long as broad in middle, 3 five times as long as broad, about equal to 4 + 5, 4 distinctly a little longer than 5, 5 twice as long as broad, remaining segments each a little shorter than the preceding, 9–12 just transverse, 13 four and a half times as long as broad, as long as 9 + 10 + 11 + 12. Clypeus a little produced, strongly convex with a distinct median keel from near base to apex which bears a strong triangular tooth on each side at a point distant from eyes by an amount equal to 4 + $\frac{1}{2}$ 5 of antennae, apex between these teeth broadly emarginate and quadrisinuate, the sinuations quite rounded. Occipital keels hardly meeting keel bounding buccal cavity, behind which there is no horizontal space. Tempora beneath shining hardly punctured. Stipes of maxillae shining, finely punctured, hairy with a strong pointed tubercle at base. Proepisternal keel almost obsolete. Pronotal collar with the angles completely rounded. Prepectus a little more closely punctured than the finely and rather closely punctured mesopectus. Mesosternum finely and not closely punctured with dense short hairs. Distance between points of posterior mesosternal lobes fully three times their length. Mesonotum finely and rather closely punctured, more sparsely on disc, shining. Scutellum flat, very shining, sparsely and finely punctured. Metanotum flat, depressions not large or deep, lateral lobes striate and hairy with a narrow raised posterior margin. Area beneath metapleural keel three times as long as broad. Metasternum pentagonal, twice as broad as long, posterior emargination a broad flat-bottomed U. Propodeum with the dorsal surface finely and moderately closely punctured with a faint depression on disc, sides finely and closely punctured, posterior surface with a deep, well-defined, rather narrow furrow to orifice, no keeled depression, angles with strong keels, together enclosing a quadrate area, angles feebly and irregularly striate on lower half only. Dorsal keel of mid coxae strong not quite on outer edge. Hind coxae with no inner dorsal keel. Hind femora with ventral lamella including only one-fifth of its length, rising symmetrically, lamella about two and a half times as broad as high, underside of femora with dense black hairs a little longer than height of lamella. Mid femora considerably thickened with dense hairs posteriorly. Fore femora with a short dense anterior fringe. Hind tibiae rounded with about twelve anterodorsal spines. Fore-wings with the last section of M_{1+2} about one and a half times the penultimate, submarginal cell about four times as long as broad in middle. First abdominal tergite with no furrow, spiracles a little projecting, spiracular area twice as broad as long, basal apophyses quite strong but not angular, apophysal area twice as long as broad. Beyond apophyses the tergite is about two-thirds as broad as length of hind trochanters, nearly three times as broad at apex, second tergite about half the length of first, a little broader at apex than long, first and second tergites moderately contracted distally, second and third quite strongly proximally, first to third with distinctly marked off apical rings. First and second unpunctured on disc, finely and sparsely punctured at sides, third finely punctured on disc, more closely on sides, fourth microscopically and closely punctured throughout. Seventh tergite not keeled. Sternites 0, 6, 6, 6, 6 with bristles respectively, sternites otherwise bare except for patches round the bases of the bristles. First sternite with a thickening at base from which projects a long hook, in profile little curved, emargination beneath it reaching anteriorly to a point a little caudad of spiracles; thickening preceding hook two and a half times as long as broad, one and a half times longer than hook, finely punctured and hairy, hook itself smooth and bare. Sternite beyond hook with traces of a depression as in *T. mexicanum.* Second sternite depressed at base, raised and rounded at apex, with a few punctures on each side of base. Fourth and especially third sternites transversely depressed at base, somewhat raised at apex. Male eighth sternite and genitalia as in *T. palliditarse,* but inner margin of stipes rather more serrate.

Female. Very close to that sex in *T. mexicanum* (Sauss.) Rohw., but the mandibles are dark with the apex a little paler (reddish pitchy), and the apophyses of the first abdominal tergite are rounded, not angularly projecting; fifth segment of hind tarsi entirely white. The truncation of the clypeus is rounded; in *T. mexicanum* it is usually, but not always, distinctly angular laterally.

Specimens examined: 1 ♂, Marianna, Penn., 11 April '21 (L.). ♀♀. One with same data as male (L.); 1 with no locality (L.); 2, U.S.A., received from Dr. Harris (L.); 2, N. America (B.); 2, Savannah, Harper (P.); 1, Berwick, Iowa, 3 July '04 (*E. S. G. Titus*) (W.), paratype of *T. politiforme* Rohwer. The species is confined to the United States.

I am unable to distinguish between the females of the three members of this subgroup. Rohwer (1912) gives characters in his original descriptions, but after the most careful study I am unable to satisfy myself that these characters have any value. Possibly a long series of bred material would make matters easier. Dr. O. Schröder kindly reported on Fabricius' type of *T. albitarse* at Kiel. It is a female of this group, though stated by Fabricius to be a S. American species. *T. striatum* Provancher (1888) may be a synonym.

T. politiforme Rohwer (1912).

Similar to *T. albitarse* F., but :—Fore femora entirely black; wings more purplish. Length 21 mm.

Supraantennal keel smaller, not on a prominence. Vertex dull and alutaceous, finely and closely punctured with a large patch on each side of the mid line just below the median ocellus more coarsely punctured. Lateral tooth at apex of clypeus blunter, the produced part wider, sinuations less pronounced. Propodeum with angles rather more strongly and regularly striate. First abdominal tergite with dorsal furrow to well beyond the spiracles; apophysal area three and a half times as broad as long; first tergite nearly four times as broad at apex as width after apophyses; second tergite one and a half times broader than long. Hook of first sternite more strongly curved, the emargination beneath it reaching anteriorly as far as spiracles.

Specimen examined: ♂ paratype, U.S.A., Berwick, Iowa, 3 May '04 (*E. S. G. Titus*) (W.).

T. neglectum Kohl (1883).

(*T. basale* Rohwer (1912)).

Similar to *T. albitarse* F., but:—Vertex usually as in *T. politiforme* Rohw.; supraantennal keel not on a prominence, represented by a small tubercle. Points of posterior mesosternal lobes a little closer together. Metasternum hardly broader than long. Propodeum with the keels on the angles hardly developed, the area enclosed between them about half as long as broad. Hind femora thickened before apex ventrally but with no lamella, thickening symmetrical and quite gradual. Apophyses of first abdominal tergite much more angular, apophysal area three and a half times broader than long. Second tergite one and a half times broader at apex than long. Hook of first sternite in profile much shorter and thicker, strongly curved, emargination beneath it not nearly reaching back to the spiracle; actually the anterior margin of the hook is opposite the spiracle.

Rohwer mainly distinguished this species on the grounds that the base of the second and third abdominal tergites were strongly impressed, but I have not found this character very satisfactory.

Specimens examined: ♂♂. 1, Waterloo, Ind. (*H. A. Link*) (W.), determined as *T. basale* by Miss G. Sandhouse; 2, Georgia, F. Smith coll. (L.); 2, Maryland, 1903 (*J. de Joannis*) (P.); 1, S. Carolina (V.) (probably the type of *T. neglectum*).

T. poultoni sp. n.

Male. Black, apical half of hind basitarsus, segments 2–4 white; segment 5 dark brown. All pubescence white. Wings evenly dark brown. Mandibles pitchy black. Length 20 mm.

Occiput a little raised behind the ocelli, shining, finely and sparsely punctured, centrally impressed. Eyes separated by the same distance at clypeus as on vertex, where the separation is nearly equal to segments 2 + 3 of antennae. Ocelli separated by about their diameter from eyes, by rather less from one another. Vertex dull alutaceous, with large shallow punctures which are separated by a little more than their diameter, centrally impressed longitudinally. Supraantennal keel low and narrow but distinct, not truncate behind. Limiting keels of the antennal scrobes practically absent. Antennal sockets separated by their diameter. Antennae with the scape twice as long as wide in middle, 3 six times as long as broad, as long as 4 + 5, 4 hardly longer than 5, 5 two and a quarter times as long as broad, 10–12 quadrate, 13 a little longer than 11 + 12, shorter than 10 + 11 + 12, three times as long as broad. Clypeus (figs. 35 and 36) unkeeled, a little produced, apex polished, whole apical margin, except a small portion (as long as antennal segment 4) on each side, strongly raised. This raised part is a little sinuate laterally. Margin seen from above weakly emarginate, seen from in front or beneath truncate, so that apex of clypeus appears very thick, this face being crescentic, about three times as broad as long. Occipital keels incomplete, horizontal space behind the buccal cavity hardly distinguishable. Tempora beneath shining, finely alutaceous, very sparsely and finely punctured. Stipes of maxillae shining hairy, moderately finely and densely punctured. Proepisternal keel rounded but distinguishable right across, the episternum at this point strongly raised so as to overhang the real posterior margin. Pronotal collar with the angles completely rounded. Prepectus a little more strongly punctured than the sparsely and finely punctured mesopectus. Mesosternum very shining, very sparsely and finely punctured, more hairy than in *T. palliditarse* Sauss. Distance between points of posterior lobes of mesosternum about twice their length. Mesonotum very shining, finely, sparsely and evenly punctured, scutellum more sparsely. Scutellum flat. Metanotum flat, lateral lobes appressed, striate and hairy, depressions large and shallow. Area beneath metapleural keel hardly defined, a little more than twice as long as broad. Metasternum more or less pentagonal, twice as long as broad posteriorly, posterior emargination a deep equilateral triangle. Propodeum with dorsal surface nearly flat, very shining, very sparsely and finely punctured, sides shining and very closely punctured, posterior surface with a moderately deep narrow furrow leading to a deep keeled depression which is feebly defined above, angles with strong keels enclosing an area a little longer than broad, angles strongly striate in the region of the keels only. Mid coxae with dorsal keel weak, not quite on outer edge. Hind coxae with an obsolescent inner dorsal keel on basal half. Hind femora raised ventrally into a lamella, not including more than one-third the length of the femur, rising gradually proximally and sinking more abruptly distally, lamella about three times as long as high, ventral surface of femur with dense white hairs as long as height of lamella. Mid femur not at all thickened, with a sparse fringe of hairs, half as long as the femur is thick. Fore femora with a rather longer and denser fringe. Hind tibiae hardly angular, anterior edge with 3–4 spines. Fore-wings with last section of M_{1+2} about one and a half times as long as the penultimate, submarginal cell four times as long as broad in the middle. First abdominal tergite with a deep broad furrow to spiracles, spiracular area one and a half times as long as broad, apophyses moderately angularly projecting, apophysal area a little broader than long. Beyond the apophyses tergite nearly as broad as length of hind trochanter, one and a half times as broad at apical margin, second tergite a little more than half as long as first, one and a half times as long as apically broad, first tergite little, second rather more contracted distally, second little, third rather more proximally, apical depressed ring of first hardly marked off. First and second tergites quite unpunctured, third dorsally with very fine sparse punctures, fourth with very fine close punctures. Seventh tergite unkeeled. Sternites with 0, 4, 4, 4, 4 bristles respectively, sternites otherwise bare except for small hair-patches round the bases of the bristles. First sternite with a strong basal hump covering rather more than a third of its length, hump closely and rather finely punctured. Second sternite a little depressed at base and again before apex, with two lines of parallel punctures at base. Third a little depressed across middle with two similar but more irregular lines of punctures. Eighth sternite as in *T. palliditarse* Sauss. Genitalia with the inner edge of stipes near base first slightly serrate, then produced into a moderately broad lamella whose distal edge is produced into one or two finger-shaped processes, volsellae forming a lobe which is distinctly emarginate distally. Sagittae with the apex upturned into a distinct hook, apex laterally with a narrow curved hook on each side.

Type. ♂, S. America (locality illegible), Wilson Saunders coll. (O.).

T. busckii sp. n.

Male. Very close to *T. poultoni* sp. n., but differs as follows :—Fifth segment of hind tarsi white; hind-wings paler at base and along dorsum; mandibles pitchy, yellowish at base. Length 17 mm.

Ocelli separated by rather less than their diameter from eyes. Antennal sockets separated by rather less than their diameter. Antennae broken at the fourth segment. Raised apical part of clypeus (fig. 37) not in the slightest degree sinuate laterally, lower edge of truncate anterior face straight, not curved, the truncate face being therefore an arc not a crescent, the arc two and a third times broader than high. Apophyses of first tergite rather weaker, apophysal area nearly twice as broad as long. Hump on first sternite smaller, covering rather less than one-third length of sternite, hump unpunctured. Stipes of genitalia with 3–5 finger-shaped processes (Pl. VII, fig. 5).

Type. ♂, Panama, Tabernilla, 23 July '07 (*A. Busck*) (W.). Paratype, ♂, Panama, Barro Colorado Is., no. 7829 (*P. Rau*) (W.).

T. barticense sp. n.

Male. Very close to *T. poultoni* sp. n., but differs as follows :—Fifth segment of hind tarsi white. Length 19 mm.

Ocelli separated by half their diameter from eyes, from one another by a little more. Supraantennal keel less distinct. Apical margin of clypeus (fig. 38), seen from beneath, not truncate but sloping directly from lower edge of produced margin towards base of labrum. Propodeum with keeled depression not defined, keels of angles together enclosing a quadrate area, angles obsoletely striate. Hind femora with lamella much lower, five times as long as high, sinking more gradually distally. First abdominal tergite distinctly narrower at base than length of hind trochanter, hardly one and a half times as broad distally, second tergite one and two-thirds times as broad distally as long. Hump on first sternite smaller, unpunctured. Genitalia with one or two longer finger-shaped processes on lamella of stipes.

Type. ♂, British Guiana, Bartica (V.).

The following females certainly belong to one of the three preceding species and I have assigned them all provisionally to *T. barticense*.

Female. Very close to *T. palliditarse* Sauss., but differing as follows :—Fifth segment of hind tarsi white; hind-wings usually paler; mandibles dark sometimes paler at base; length 17–19 mm.

Ocelli usually separated by about half their diameter from eyes, or less (rarely by as much as two-thirds). Angles of propodeum usually more feebly striate.

Allotype. ♀, British Guiana, Essequibo, Moraballi Creek, 8 Sept. '29, "gathering mud," no. 1771 O.U.Exped. Brit. Guiana (L.). Paratypes. *British Guiana :* 3 ♀♀, Moraballi Creek, 21, 25 and 26 Aug. '29, nos. 503, 803 and 841 O.U.Exped. Brit. Guiana (L.). *Dutch Guiana :* 5 ♀♀, Surinam, 3 ♀♀ (V.), 2 ♀♀ (B.). *French Guiana :* 2 ♀♀, Cayenne, Lacordaire (B.). *Brazil :* ♀, Para, Aug. '19 (*G. Arnold*) (L.) : ♀, Obidos (*H. Rolle*) (V.).

A female, Panama, Bugaba 800–1000 ft. (*G. C. Champion*) (B.C.A.), may perhaps belong to *T. busckii*, but it is not structurally distinguishable, except that the ocelli are separated by about two-thirds their diameter from the eyes.

T. aestivale sp. n.

Male. Black, apical half of hind basitarsus, segments 2–4 white; 5 brown. All pubescence white, nowhere very dense. Wings evenly dark brown, hind-wings paler, especially at base. Mandibles pitchy with a red mark in the middle. Length 14 mm.

Occiput not raised or impressed, moderately shining, finely alutaceous and very finely and sparsely punctured. Eyes a little closer together at clypeus than on occiput where separated by a distance equal to 2 + 3 of antennae. Ocelli separated by one and a half times their diameter from eyes, by a little less from one another. Vertex dull, very finely alutaceous, with close, large shallow punctures with flat bottoms (not quite as close as in *T. pallidutarse* Sauss.). Supraantennal keel hardly developed, represented by a smooth line, with traces of a truncation behind, joined to median ocellus by a faint furrow. Limiting keels of antennal scrobes not developed. Antennal sockets separated by their diameter. Antennae with scape twice as long as broad in middle, 3 five times as long as broad, as long as 4 + 5, 4 about as long as 5, 5 about twice as long as broad, 9–12 quadrate, 13 three times as long as broad, as long as 10 + 11 + 12. Clypeus a little produced, apex polished, a very obtuse central keel, central half of apical margin produced and convex, sides of this portion defined by blunt points, between these points a small central one. Occipital keels incomplete, no horizontal space behind the buccal cavity. Tempora beneath shining, finely and sparsely punctured. Stipes of maxillae flat, shining, closely and rather strongly punctured. Proepisternal keel rounded but traceable. Pronotal collar rather sharply angular. Prepectus with rather closer punctures than the sparsely but moderately strongly punctured mesopectus. Mesosternum finely and sparsely punctured with short, not dense hairs. Distance between points of posterior mesosternal lobes two and a half times their length. Mesonotum shining, finely but moderately closely punctured, except the central disc. Scutellum flat very sparsely punctured. Metanotum flat, finely and closely punctured, lateral lobes appressed, striate, hairy, preceded by large shallow depressions. Area beneath the metapleural keel hardly more than twice as long as broad. Metasternum pentagonal, a little longer than broad, with a deep V-shaped emargination behind. Propodeum with dorsal area flat, sparsely and very finely punctured, sides finely and moderately closely punctured, posterior surface with a deep well-defined furrow to orifice, no keeled depression, dorsally furrow runs as a distinct shallow depression on to dorsal area, angles with strongly diverging keels enclosing together an area a little longer than broad, angles rather strongly and regularly striate right up on to dorsal surface. Dorsal keel of mid coxae strong, right on outer edge. Hind coxae with a rather strong inner dorsal keel for its basal two-thirds. Hind femora strongly clavate in dorso-ventral plane, gradually thickened from base and sinking more abruptly from a point three-quarters of its length from base, at thickest point two and a half times as thick as at base, femur absolutely bare. Mid femur a little thickened nearly bare. Anterior femur with short moderately dense hairs. Hind tibiae scarcely angular, with no strong bristles. Fore-wings with last section of M_{1+2} one and a half times as long as the penultimate, submarginal cell three and two-thirds times as long as broad in the middle. First abdominal tergite with a feeble furrow to spiracles, which project a little, spiracular area fully twice as long as broad, apophyses weak running into tergite in a smooth curve, apophysal area at base twice as broad as long. Beyond the apophyses the tergite is not quite so broad as the length of the hind trochanters, fully twice as broad at apical margin, second tergite more than half length of first, one and a half times as long as broad at apex, first and second moderately contracted distally, second and third moderately proximally, first with a feeble apical ring marked off, others with none. Tergites one and two unpunctured except at sides, three and four, under high power, with very fine close punctures. Seventh tergite not keeled. Sternites with 0, 6, 6, 6, 6 bristles respectively, sternites otherwise bare and shining except for a few hairs round the bases of the bristles. First sternite simple, basal quarter hairy and punctured. Second quite unpunctured, depressed at base, rather strongly raised at apex, centre of raised portion with a small depression. Third depressed on its basal half. Eighth sternite (Pl. VI, fig. 3) produced apically into tapering prongs, proximally with dorsal surface produced into a triangular process. Genitalia (Pl. VII, fig. 1) with stipes-squama narrow at apex and broader at base, where it is produced dorsally into a broad lamella (Pl. VII, fig. 2), whose edge is a little serrate, volsellae forming together an obtuse lobe somewhat emarginate distally, sagittae curved up at apex into broad oval lobes.

Female. Very similar to that of *T. palliditarse* Sauss., but :—Fifth segment of hind tarsi brown, hind-wings hyaline on basal half. Mandibles pitchy black. Length about 16 mm.

Occiput distinctly alutaceous and punctured. Ocelli separated by from one to one and a half times their diameter from eyes. Clypeus almost keeled. Angles of pronotal collar distinctly angular. Inner dorsal keel of hind coxae distinct on their basal half. Propodeum with angles rather irregularly striate, with some punctures amongst the striae.

Type. ♂, Brazil, Rio Grande do Sul (*Stieglmayr*) (V.). Allotype. ♀, Brazil, Biske (V.). Paratypes. ♂♂. *Costa Rica :* 1, Pedras Negros (*Böttcher*) (R.). *Brazil :* 1 (B.); 1, environs of Rio de Janeiro (*Mayer*) (B.). ♀♀. *Venezuela :* 1, Merida, coll. Pérez (P.). *Brazil :* 1 (O.); *Paraguay :* 1, Alto Parana, Puerto Bertoni, Feb. '09 (*W. Bertoni*) (B.).

A male, British Guiana, Blairmont, Oct.' 23, no. 43 (notes p. 121) (*F. X. Williams*) (W.), differs in that the basal apophyses of the first abdominal tergite are subangularly projecting. It is probably no more than a variety.

It is, of course, possible that some of the females belong to one of the allied species.

T. fuscipenne Fabricius (1804), nec auctt.

Male. Similar to *T. aestivale* sp. n., but :—Only extreme base of hind basitarsus dark, fifth segment pale brown. Wings dark brown with dark metallic reflections, dorso-basal half of hind-wings hyaline. Mandibles black. Length 14 mm.

Occiput quite dull, hardly punctured. Ocelli separated by rather less to rather more than their diameter from eyes, by rather more from one another. Vertex rather less closely punctured. Supraantennal keel rather more raised but very short. Clypeus (fig. 34) less produced, less convex, the three apical points present but smaller. Tempora beneath and stipes of maxillae almost unpunctured. Mesothorax throughout very sparsely and obsoletely punctured. Striae of angles of propodeum rather finer, dorsal surface and sides unpunctured. First abdominal tergite with no dorsal furrow, spiracular area nearly three times as long as broad, apophyses not at all angular, apophysal area two and a half times as wide proximally as long. Hind femora with thickening quite gradual, at thickest point twice as thick as at base. Genitalia with basal lamella of stipes-squama hardly developed (Pl. VII, fig. 4).

Female. Similar to *T. aestivale* sp. n., but :—Ocelli separated by half to two-thirds their diameter from eyes; fifth segment of hind tarsi white.

The type is a female in the Sehestedt collection at the Copenhagen Museum. It was kindly examined for me by Mr. K. L. Henriksen and agrees with the female of *T. fuscipenne* as here defined. Being a female it will be impossible to be sure that the males belong to the same species, but the name may be used until additional evidence is available.

The type was described from S. America. Specimens examined : ♂♂. *British Guiana :* 3, Moraballi Creek, Essequibo, bred nest in store tent, 26 Oct. '29, no. 4814 O.U.Exped. Brit. Guiana (L.). *Brazil :* 1, coll. Winthem (V.). "*S. America*" : 1, coll. Leprieur (P.). ♀♀. *Mexico :* 1, Orizaba (*Biart*), 1862 (P.). *Costa Rica :* 1, San Carlos (*Böttcher*) (B.). *Guatemala :* 1, Cayuga, June '15 (*W. Schaus*) (W.). *Colombia :* 3, Bogota (*Lindig*) (B.). B. W. I. : 1, Trinidad Oct. '33 (*D. Vesey FitzGerald*). *British Guiana :* 1, Moraballi Creek, Essequibo, bred nest in store tent, 26 Oct. '29, no. 4814 O.U.Exped. Brit. Guiana; 2, Issororo, N.W. District, July '26 (*C. B. Williams*), no. 1137–8 (B.G.); 1, Essequibo, Tumatumari, Dec. '15 (*G. E. Bodkin*), no. 1082 (B.G.).

Dutch Guiana: 1, Surinam, coll. de Gaulle (P.). *Brazil:* 1, Bahia (*Winthem*) (V.); 1, Maragão, 26 May '00 (*Ducke*) (V.). No locality. 1 (P.).

It is probable that some of the females from the more northerly localities may belong to one of the other species. In a few of the females the apical part of the fifth tarsal segment is more or less darkened.

T. albonigrum sp. n.

Male. Similar to *T. aestivale* sp. n., but :—Hind tarsi with fifth segment almost entirely black. Wings dark with metallic reflections. Size rather larger, but abdomen, after the first segment, is missing.

Occiput quite dull, moderately closely and finely punctured. Supraantennal keel with no trace of a truncation posteriorly. Antennae with 4 a little longer than 5, 9–10 quadrate, 11–12 a little transverse, 13 a little longer than 10 + 11 + 12, hardly more than three times as long as broad. Clypeus not keeled, central produced portion broader and less convex, points at the side quite strong but no central point. Mesopectus rather more finely punctured. First abdominal tergite with no furrow, spiracular area just twice as long as broad, apophyses angular but not very strongly projecting, apophysal area three times as wide at base as long. Hind femora thickening more gradually, but at thickest fully twice as thick as at base, thinning again suddenly towards apex.

Type. ♂, Brazil, Blumenau, 1885 (*Hetschko*) (V.).

T. atkinsoni sp. n.

Very similar to *T. aestivale* sp. n., but :—Fifth segment of hind tarsi white. Length 14 mm.

Occiput somewhat shining, not punctured, almost transversely keeled. Ocelli separated by a little more than their diameter from eyes, by distinctly more than they are from one another. Median furrow of vertex rather strong. Mesopectus more finely and sparsely punctured. Sides of dorsal area of propodeum hardly visibly punctured. First abdominal tergite with no furrow, spiracular area two and a half times as long as broad, apophyses strong, distinctly angular, apophysal area one and two-thirds times as broad as long. Hind femora gradually thickened to apex, at thickest one and three-quarters as thick as at base. Genitalia with the lamella of stipes-squama (Pl. VII, fig. 3) longer and narrower than in *T. aestivale* but broader than in *T. fuscipenne* F.

Type. ♂, Colombia, Cincinnati, Feb. '24 (*H. W. Atkinson*) (W.). Paratypes. 3 ♂♂, Panama, Barro Colorado Is., no. 7527 (*P. Rau*) (W.). These paratypes are somewhat intermediate between the present species and *T. spatulatum* which may not be distinct. They have the thorax even more sparsely punctured than the type, and the prongs of the eighth sternite are a little spatulate.

A further ♂, Bolivia, Rurrenabaque, Rio Beni, Nov. (*W. M. Mann*) (W.), probably belongs to this species.

T. spatulatum sp. n.

Hardly distinguishable externally from *T. atkinsoni* sp. n., but :—Occiput more shining, not alutaceous, not transversely keeled. Ocelli separated by their diameter from eyes. Mesopectus absolutely without punctures, mesonotum also more finely punctured. Prongs of eighth sternite (Plate VI, fig. 1) strongly spatulate at their apex. Genitalia similar. Length 14 mm.

Type. ♂, Mexico, Tabasco (*W. Gugelmann*) (B.).

GROUP OF *T. SUPERBUM* SM.

Antennal sockets separated by two-thirds to one diameter. Limiting keels of antennal scrobes weak or strong, but never more than a tubercle at the upper inner edge of socket. Vertex with a central longitudinal keel and another one at right angles to it just below the median ocellus. Clypeus in female with four apical teeth, the central pair more projecting, in the male tri- or quadridentate, with only sparse outstanding hairs, a little higher than least width between eyes below. Mandibles simple in the female, in the male sharply bent near the base, sickle-shaped. Occipital keels incomplete, horizontal space behind the buccal cavity broad. Lateral tubercles of the pronotum elongate, usually rather weak, sometimes sharp-edged. Angles of pronotal collar not bordered. Proepisternal keel absent or very weak. Prepectus not crossed by any keels or furrows. Mesopleural suture very short or absent. Furrow in front of the mid coxae weak, at most with a few keels crossing it. Metapleural keel moderately rounded (intermediate), area defined. Lateral lobes of postnotum hyaline, moderately high, edge not downcurved or only a very little. Furrow joining depressions in metapleural-propodeal suture very weak or obsolete, not crenate. Dorsal margin of orifice of propodeum broad and flat, orifice about twice as broad as high. Fore coxae with no strong apical bristles in the female, keels variable in strength, usually nearly parallel to one another. Dorsal keel of mid coxae unusually strong. Inner dorsal keel of hind coxae strong, oblique, rim to emargination unusually strong, especially externally. Fore-wings with costa not or hardly produced beyond the radial cell, last section of M_{3+4} and im_1 set at an angle of 110–135°, last section of M_{1+2} two and two-thirds to three times longer than the penultimate. Two groups of hamuli on hind-wings consisting of 6–7 and 5–6 (the outer group) hooks each, the groups separated by the length of the apical row. At least sternites 4 and 5 considerably hairy, at any rate in the female; second sternite with 1–2, the remainder with 2–4 bristles on each side. Male with eighth sternite bearing two widely separated apical prongs. Male genitalia with stipes and squamae completely fused, very long and narrow, gradually tapering; volsellae of the two sides only fused proximally, but contiguous internally for most of their length, very small; no basal or basi-lateral lobe to the volsellae; sagittae long, narrow, parallel-sided, a little divergent at the apex, which is simple : cardo a very narrow ring.

Species often considerably testaceous marked, pubescence brassy. A neotropical group.

As far as I can judge from the description the following species may also belong here :—

T. correntinum Brèthes (1909, p. 67), Argentina, Prov. Corrientes.

T. cariniceps sp. n.

Female. Black, mandibles and tegulae piceous. Underside of segments 1–3 of antennae indeterminately, palpi, legs except fore trochanters and dorsal surface of four hind trochanters, testaceous. Wings fuscous. Pubescence brassy. Length 12·5 mm.

Occiput smooth, somewhat shining. Eyes a little closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by two-thirds their diameter from eyes, by their diameter from one another. Vertex dull, finely coriaceous, central impression obsolete, transverse keel hardly longer than distance between inner edges of lateral ocelli, separated from median ocellus by two and a half times the diameter of the latter. Supraantennal keel strong but short, hardly longer than antennal segment 2, separated by more than twice its length from the transverse keel. Limiting keels of antennal scrobes hardly developed, forming a mere tubercle on the upper edge of the antennal socket. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times longer than broad, much shorter than 4 + 5, 4 a little longer than 5 which is nearly three times as long as broad, remaining segments all considerably longer than broad, 12 one and a half times longer than 11, two and a half times longer than broad. Clypeus hardly keeled, apical margin produced in the centre, the produced part very shallowly emarginate, the clypeal margin on each side of it distinctly emarginate, the emarginations being distinctly broader than the apex of the produced part. Occipital keel incomplete, horizontal space behind the buccal cavity moderately broad. Tempora beneath finely alutaceous, moderately shining. Stipes of maxillae smooth and shining. Proepisternal keel hardly traceable. Pronotal collar with centre not, angles distinctly prominent. Mesopleuron sparsely and rather finely punctured. Mesonotum and scutellum dull, closely and finely punctured, the latter flat. Metanotum flat, finely punctured, lateral lobes very narrow, posterior margin hyaline and outstanding, depressions large and shallow. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface flat, dull, finely striate. Posterior surface with a deep narrow furrow, well defined above and continuing so almost to orifice, no keeled depression, angles without keels, with rather strong, widely spaced, regular striae. Sides rather dull, finely striate. Hind coxa with inner dorsal keel and rim to emargination weaker than in other species of group. First abdominal tergite with practically no furrow, spiracular area twice as long as broad, apophyses obsolete, tergite at base hardly as broad as length of hind trochanter, twice as broad at apex, rather longer than hind femur + trochanter. Second tergite half as long as first, about as long as broad at apex. First tergite strongly, second moderately contracted at apex. Sixth tergite not keeled. Sternites with a triangular, sparsely pubescent patch at apex of 3, a more distinct one on 4, and the whole apical half of 5 pubescent.

Type. ♀, Coroico, Bolivia (B.).

T. saundersi sp. n.

Female. Black, antennae except dorsal marks on segments 2–7, apical half of clypeus, mandibles, prosternum, legs except four hind coxae and a dorsal shade on the femora, sides of abdominal tergite 1 and base of tergites 2–4, reddish-yellow. Wings yellowish, darker at apex, venation yellow. Pubescence bright golden. Length 13 mm.

Structurally similar to *T. cariniceps* except in the following characters :—Eyes a little further apart at clypeus than on occiput where separated by nearly the length of antennal segments 2 + 3. Ocelli separated by one-third their diameter from eyes, by two-thirds from one another. Vertex with transverse keel about as long as distance between outer edges of lateral ocelli, separated from median ocellus by twice its diameter; supraantennal keel separated from it by rather more than its own length. Antennal sockets separated by two-thirds their diameter. Lateral emarginations of clypeus deep, as broad as produced part which is narrower. Centre of pronotal collar a little prominent. Mesonotum and scutellum dull, alutaceous, finely and closely punctured. Posterior surface of propodeum with a strong, longitudinal keel down the centre of the undefined keeled depression, angles smooth, unpunctured. Sides smooth, unpunctured, with traces of striae. Abdominal sternites bare, 4 and 5 pubescent almost throughout.

Type. ♀, "Colum. Chart." (O.). (? Colombia).

T. superbum Smith (1873).

Female. Black, antennae with segments 1–5, apical half of 12 and 6–7 beneath, apex of clypeus, mandibles, proepisternum, dorsal collar of pronotum, tegulae, legs, abdominal tergites 1–3 (except for apical disc of 1–3) and 4–6 more or less indefinitely, testaceous. Wings hyaline, a little darker at apex. Pubescence dense, brassy. Length 14 mm.

Structurally similar to *T. cariniceps* sp. n. except in the following characters :—Eyes distinctly closer at clypeus than on occiput where separated by a distance equal to length of antennal segment 3. Vertex with impression connecting median ocellus to transverse keel strong. Ocelli separated by one-third their diameter from eyes, by two-thirds their diameter from one another. Supraantennal keel much longer, longer than scape, nearly meeting transverse keel, which is separated from median ocellus by twice diameter of latter. Limiting keels of antennal scrobes obsolete. Clypeus more clearly carinate, with emarginations on each side of central production as wide as the latter which is broad and quite deeply emarginate. Pronotal collar with angles and usually centre distinctly prominent. Mesonotum more shining, sparsely punctured. Posterior surface of propodeum with furrow ending before orifice, sides very finely punctured.

Male. Antennae with segment 3 as long as 4 + 5, 4 a little longer than 5, twice as long as broad, remaining segments progressively shorter till 12 is quadrate, 13 a little shorter than 11 + 12, twice as long as broad. Emarginations of clypeus (fig. 44) deeper so that it appears quadridentate, central pair of teeth closer together. Mandibles bent at right angles at base. Seventh abdominal tergite keeled, keel projecting as a hook.

There are three forms of this species which may, with more adequate material, prove to be geographical races.

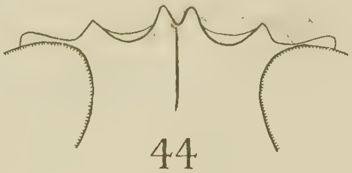


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FIG. 44.—Antero-dorsal view of clypeus of *T. superbum* Sm., male.

1. *T. superbum superbum* Smith (1873).

Thorax black, only collar and lower margin of propodeum pale. Antennae with segments 1–5 pale, 6–7 pale beneath, apical half of 12 pale. Abdomen with 1 except apex and base of 2–3 pale, 4–6 definitely darker. Wings pale. Centre of collar usually more prominent. Supraantennal keel nearly meeting transverse keel of vertex, separated from it by much less than its own length. Length 14 mm.

Specimens examined: Type. ♀, Brazil, Ega (L.). Other specimens. ♀, Ega (L.); 2 ♀♀, Brazil, Amazons (O.); ♀, no locality, Smith coll. (L.). Only the type specimen has the abdomen definitely darker on segments 4–6.

2. *T. superbum fulvipes* Cameron (1889).

Thorax black, collar, prepectus, mesopectus except dorsal patch, lower half of metapleuron, pale. Antennae with segments 1–6 and 12 pale, 7–11 pale beneath. Abdomen pale, apex of 1–3 brownish. Wings pale. Centre of collar hardly prominent. Supraantennal keel shorter, separated from the transverse keel of vertex by its own length. Length 12·5 mm.

Specimens examined: Type. ♀, Panama, Bugaba (*Champion*) (B.C.A.). Other specimens (in none of these is the mesopleuron and metapleuron pale). *Panama:* ♀, Close's Cano Saddle, 9 May '25 (*R. C. Shannon*) (W.); ♂, Cano Saddle, Gatun Lake, 27 April '28 (*R. C. Shannon*) (W.); ♂♀, Limon, Chagres River, 14 Oct. '18 (*Dietz* and *Zetek*) (W.).

The colour of the abdomen appears to be on the average a little paler in the present form but there is complete intergradation as far as that character is concerned.

3. **T. superbum superciliosum** var. n.

Thorax black, collar of pronotum only pale posteriorly. Antennae with 1–4 rather dark brown, 5–7 pale beneath, 12 pale at apex. Abdomen black, only sides of 1 pale. Wings rather dark brown. Centre of collar hardly prominent. Supraantennal keel shorter, separated by its own length from transverse keel of vertex. Length 14 mm.

Type. ♀, Bolivia, Coroico (B.).

T. olfersi sp. n.

Female. Black, scape of antennae and indeterminate marks on segments 2–3, apex of clypeus, mandibles, palpi, posterior margin of proepisternum, pronotum indeterminately, all legs except dorsal surface of four hind coxae, sides of abdominal tergites 1–3 and base of tergites 2 and 3 indeterminately, yellowish-testaceous. Wings yellowish-fuscous, venation yellow. Pubescence light brassy. Length 12·5 mm.

Structurally similar to *T. cariniceps* except in the following characters :—Occiput behind ocelli raised into a fine but strong transverse keel. Eyes distinctly closer together at clypeus than on occiput where separated by a distance equal to the length of segments 3 + half 2 of antennae. Ocelli separated by hardly more than one-third their diameter from eyes, by nearly their diameter from one another. Vertex with central impression weak but distinct, transverse keel distinctly longer than the distance between the outer edges of the lateral ocelli, separated from the median ocellus by one and a half times its diameter. Supraantennal keel (= scape) separated by half its length from transverse keel. Limiting keels of antennal scrobes strong though very short. Clypeus with central projection shallowly emarginate, as broad as lateral emarginations. Mesonotum and scutellum sparsely and very obsoletely punctured, shining. Posterior surface of propodeum with traces of an ill-defined keeled depression, angles scarcely punctured, shining. Sides shining, closely and finely punctured. First abdominal tergite with spiracular area quadrate, tergite only one and a half times broader at apex than at base. Sternites bare, 4 and 5 with the apical half pubescent.

Type. ♀, Brazil (*von Olfers*) (B.). Paratype. ♀, Brazil, Santa Catharina, Thersepolis (*Michaelis*) (B.). In the paratype the four hind legs are mainly dark and the wings are darker.

The following specimen is probably only a colour-variety.

Female. Antennae pale except for dorsal surface of segments 8–10, whole pronotal collar and whole abdomen yellowish-testaceous.

♀, Ega, Brazil (L.).

T. monstrificum Kohl (1905).

Male. Black, antennae except for a dark shade on segments 7–11, apical half of clypeus, mandibles, mentum, whole prothorax, tegulae, legs (including coxae), posterior part of mesosternum, metasternum, posterior margin of propodeum, abdomen except for brown shades at apices of tergites 2–7, ochreous-yellow. Wings hyaline. Pubescence brassy. Length 8 mm.

Resembles *T. cariniceps* but differs as follows :—Eyes distinctly closer at clypeus than on occiput, where separated by a distance equal to length of segments 2 + 3 + 4 of antennae; eyes divided into upper and lower halves by a furrow at level of internal emargination, which is much smaller than usual, part of the eye below this furrow strongly swollen, bulging out far beyond the rest of the eye. Ocelli separated by half their diameter from eyes. Limiting keels of antennal scrobes in the form of strong tubercles. Antennal sockets separated by half their diameter. Antennae with 3 three times as long as broad, as long as 4 + 5, 4 and 5 subequal one and a half times as long as broad, remaining segments progressively shorter till the penultimate segments are nearly quadrate, 13 twice as long as broad, not as long as 11 + 12. Clypeus with whole apical margin rectangularly produced into a plate about five times as long as broad bearing four strong teeth. Mandibles bent at right angles near base. Tempora beneath broader than usual. Mesothorax very shining, very sparsely and finely punctured. Metasternum scarcely emarginate. Propodeum with dorsal surface unpunctured but defined by the direction of the pubescence. Posterior surface with a small keeled depression, angles finely punctate-striate. Sides finely punctate-striate. First abdominal tergite with no furrow, spiracular area quadrate. Seventh tergite with keel projecting beyond apex as a hook.

Specimen examined: Type. ♂, Bolivia (V.).

The description is not quite as full as it might be since the specimen had to be returned before the final comparison of all the material in this group was made.

T. carinifrons Cameron (1889).

Female. Black, mandibles hardly paler, antennae 1–6 beneath and apical half of 12, front coxae and trochanters, all femora except for a dorsal streak, tibiae and front tarsi, proepisternum posteriorly, narrow apex of first abdominal tergite, first sternite except two dark spots at apex, basal half of second segment, reddish-yellow. Wings hyaline with radial cell and apex darker, stigma testaceous. Pubescence very pale brassy, except on face where silvery. Length 11 mm.

Structurally similar to *T. cariniceps* sp. n. except in the following characters:—Eyes equally separated above and below. Ocelli separated by scarcely so much as one-third their diameter from eyes, by two-thirds their diameter from one another. Vertex with a very weak central impression, transverse keel not quite as long as distance between outer edges of lateral ocelli, separated from median ocellus by twice its diameter. Supraantennal keel separated by its length from transverse keel. Emarginations on each side of produced part of clypeus as broad as the produced part which is narrow and weakly emarginate. Mesonotum shining, more sparsely punctured. Posterior surface of propodeum with a keeled depression.

Specimens examined: Type. ♀, Mexico, Vera Cruz, Atoyac, May (*H. H. Smith*) (B.C.A.).

The following male probably belongs to this species. It differs as follows:—

Legs and antennae darker, the latter only indeterminately pale at base, mandibles black. Pubescence denser and brighter. Length 9 mm.

Eyes hardly closer together below than above. Ocelli separated by two-thirds their diameter from eyes. Antennae with all segments rather shorter and thicker, 13 twice as long as broad, as long as 11 + 12. Mandibles bent through a right angle near base. Clypeus with the central projection forming a strong, acute, triangular tooth, projecting far beyond the small lateral ones from which it is separated by shallow emarginations. Propodeum with keeled depression obsolete. Seventh tergite keeled, the keel projecting as a hook.

♂, Costa Rica, La Caja, near San José (*P. Serre*) (P.).

GROUP OF *T. SPINOSUM* CAM.

Antennal sockets separated by from two-thirds to one diameter of a socket. Limiting keels of antennal scrobes, if developed, parallel or slightly diverging. Clypeus with the apical margin tridentate in the male and usually less obviously in the female also, with never more than sparse outstanding hairs, height about equal to the least distance between the eyes below. Mandibles simple. Occipital keels incomplete (except in *T. sonorense* Cam.), horizontal space behind the buccal cavity distinct. Lateral tubercles of pronotum elongate, sharp-edged. Angles of pronotal collar not bordered. Proepisternal keel usually strongly marked. Prepectus with at most very slight traces of dorsal furrow (practically hidden by the pronotal tubercle) and sometimes (*T. nattereri* sp. n.) a trace of a ventral keel in the region close to the proepisternum. Mesopleural suture usually more or less developed. Furrow in front of mid coxae more or less strong, usually distinctly crenate. Metapleural keel strongly curved, area not defined (except *T. nattereri* sp. n.). Lateral lobes of postnotum (fig. 19) forming very large, ear-shaped expansions, usually of a testaceous or yellowish colour. Furrow joining depressions in the metapleural-propodeal suture not strong, at most weakly crenate. Dorsal margin of orifice of propodeum broad and flat, sometimes sloping in towards orifice which is much broader than high. Fore coxae without apical bristles in the female, both keels more or less developed, usually convergent. Mid coxae with a more or less strong keel on their outer edge. Hind coxae with inner dorsal keel strong, produced to apex of coxa where (in all but *T. nattereri* sp. n., *T. tridentatum* Pack. and *T. projectum* Fox) it is distinctly separated from the emargination for the reception of the trochanter.

Male hind trochanters with a spine or raised lamella ventrally, except *T. tridentatum* Pack. and *T. projectum* Fox in which the same sex has strong dorsal tubercles on the propodeum. Dorsal area of propodeum more or less depressed centrally and crossed by transverse striae which may be nearly hidden by dense hairs. Fore-wings with the costa not produced beyond the radial cell, last section of M_{3+4} and im_1 set at angle of usually 135°, rarel as little as 110°, last section of M_{1+2} 1–2 times as long as the penultimate. Two groups of hamuli on the hind wings consisting of 6–9 and 6–11 hooks each, separated by ½–1 times the length of the apical group. Sternites 2–5 bare and shining with at most a few hairs round the bases of the bristles. At least sternites 3–5 with two or three bristles on each side. Seventh tergite of male with an apical keel which projects as a hook. Eighth sternite of male produced at apex into two long prongs. Male genitalia with the stipes and squama completely fused, long and narrow with a membranous expansion along their inner edge, volsellae short, circular or oval, basally fused, with a small basal lobe connecting with the stipes, sagittae variable as to width, strongly bent downwards with the apex more or less recurved (Pl. VII, figs. 6–10).

Size moderate to large (length 12–19 mm.), at least abdomen usually pale marked. The species are found throughout America.

The following species, known to me only from their descriptions, appear to belong to this group, but I cannot identify them with any species I have examined :—

T. saussurei Rohwer (1912, p. 478) = *T. mexicanum* Saussure (1867, p. 78) nec *T. albitarse* var. *mexicanum* Saussure (1867, p. 77), Mexico. Apparently allied to *T. apicipenne* Cam.

T. xantianum Saussure (1867, p. 78), Mexico. Near *T. projectum* Fox and *T. tridentatum* Pack.

T. rufozonale Fox (1891, p. 145), Colorado. Near *T. sonorense* Cam.

T. aureolum Rohwer (1909, p. 381), Texas. Near *T. texense* Sauss.

T. quintilis Viereck (1906, p. 206), Kansas. Near *T. clavatum* Say.

This species-group (*T. tridentatum* Pack., etc.) runs very close to that of *T. nitidum* Sm. (subgroup of *T. excavatum* Sm.). In the present group, the aedeagus is strongly bent downwards (Pl. VII, figs. 6 and 8). In *T. excavatum* Sm. (Pl. VIII, fig. 3), it is hardly bent downwards at all.

T. projectum Fox (1891).

Female. Black, mandibles and tegulae piceous; narrow base of all tibiae, annulations of four front tarsi, paler; hind tarsi with apex of first segment and whole of 2–4, yellowish-white; sides of first two abdominal segments reddish-testaceous. Wings evenly fusco-hyaline. Pubescence silvery, rather dense on angles of propodeum. Length 13 mm.

Occiput shining, a little raised, scarcely depressed in centre, sparsely and rather finely punctured. Eyes hardly closer at clypeus than on occiput where separated by a distance nearly equal to segments 3 + 4 of antennae. Ocelli separated by two-thirds their diameter from eyes, by three-quarter diameters from one another. Vertex not very shining, faintly alutaceous with dense shallow punctures separated by less than half their diameter, with a weak central impression. Supraantennal keel strongly raised with a fine dorsal keel, posteriorly vertically truncate, the truncation larger than one of the posterior ocelli. Limiting keels of antennal scrobes short and very fine, as long as two-thirds the diameter of antennal sockets. Antennal sockets separated by their diameter. Antennae with scape only one and a third times longer than its greatest width, 3 four times longer than broad, shorter than 4 + 5, 4 longer than 5 which is twice as long as broad, penultimate segments a little longer than broad, 12 not quite as long as 10 + 11, nearly twice as long as broad. Clypeus with a distinct central keel, central third of apex distinctly produced, production emarginate, forming two teeth. Occipital keel strong, incomplete, horizontal space behind the buccal cavity moderately broad. Tempora beneath shining, sparsely and finely punctured. Stipes of maxillae shining, sparsely punctured. Proepisternal keel distinct but not very sharp, rounded at sides and with a blunt tooth at centre. Mesopleuron moderately closely and not very strongly punctured. Pleural suture extending half-way up the pleuron. Mesonotum and scutellum shining, moderately sparsely and strongly punctured, the latter flat. Metanotum flat, sparsely and finely punctured, lateral lobes with three keels, posterior margin a little raised, hyaline, depressions shallow and elongate. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface little depressed, finely cross-striate. Posterior surface with a rather narrow furrow to near the orifice, keeled depression ill-defined, angles without keels, coarsely and irregularly striate. Sides closely and finely punctured, with obsolescent striae, shining. First abdominal tergite with a furrow to little beyond the spiracles, spiracular area quadrate, apophyses weak, tergite at base distinctly broader than length of hind trochanter, one and a half times wider at apex, as long as hind femur and trochanter. Second tergite two-thirds as long as first, two and a quarter times longer than broad at apex. First tergite very strongly, second and third strongly contracted at apex. Sixth tergite with a keel on its apical half. Sternites bare.

Male. Vertex with no central furrow. Antennae with segments 8–10 quadrate, 11–12 transverse, 13 not quite as long as 10 + 11 + 12, nearly three times as long as broad. Emargination at apex of clypeus shallower. Dorsal surface of propodeum raised into sharp angular tubercles on each side of the top of the furrow. First two abdominal tergites rather less broadened to the apex. Seventh tergite with keel projecting beyond the apex as a small hook. First sternite rugose on basal third, beyond this with an elliptical impression. Third sternite with a large central depression, apex and sides raised. Hind trochanter with a distinct keel on its inner edge.

Specimens examined: ♀, Nelson Co., Virginia, 8 July '28 (*W. Robinson*) (det. Sandhouse) (W.); ♂, Washington D.C. (*Chittenden*) (compared with type by Sandhouse) (W.).

T. tridentatum Packard (1867).

Female. Black, swollen apex and sides of first abdominal tergite, sternite 1, whole of segment 2, narrow base to tergite 3, red. Hind tarsi with the apical half of the basitarsus and segments 2–4, yellowish. Wings hyaline with the apex darker. Pubescence silvery. Length 14 mm.

Occiput shining, little raised, centre hardly depressed, very sparsely punctured. Eyes hardly closer at clypeus than on occiput where separated by a distance rather greater than the length of antennal segments 2 + 3. Ocelli separated by two-thirds their diameter from eyes, by about their diameter from one another. Vertex shining, coarsely and rather closely punctured with a distinct central impression. Supraantennal keel strongly raised, truncate posteriorly, the truncation subcircular and fully as large as one of the posterior ocelli. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by their diameter. Antennae with scape one and a third times as long as greatest width, 3 four times as long as broad, shorter than 4 + 5, 4 a little longer than 5, which is a little more than twice as long as broad, remaining segments all a little longer than broad, 12 two and a half times longer than broad, shorter than 10 + 11. Clypeus with the apical margin polished and a central keel distinct as far as the polished margin, apex with two strong teeth separated by a deep U-shaped emargination and a minute, more lateral tooth on each side. Occipital keel strong, incomplete, horizontal space behind the buccal cavity moderately broad. Tempora beneath shining, sparsely but quite strongly punctured. Stipes of maxillae shining, indistinctly punctured. Proepisternal keel only well marked towards the centre, not produced into teeth, the rounded tubercle also sending a small keel inwards. Mesopleuron moderately strong and closely punctured. Pleural suture strong, extending half-way up the pleuron. Mesonotum and scutellum moderately closely and finely punctured, the latter flat. Metanotum flat, very sparsely punctured, lateral lobes striate, posterior margin not hyaline, depressions shallow. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface depressed over a triangular central area, transversely striate, posteriorly, on each side of the furrow, raised into a small tubercle. Posterior surface with a furrow to the orifice, keeled depression large, ill-defined, angles with no keels, strongly striate. Sides striate with obsolete punctures. First abdominal tergite with a furrow for half its length, spiracular area a little longer than broad, apophyses strong, tergite at base as broad as length of hind trochanter, one and two-thirds times as wide at apex, as long as hind femur and trochanter. Second tergite two-thirds as long as first, twice as long as apical width. First two tergites strongly contracted at the apex. Sixth tergite keeled almost throughout its length. Sternites bare.

Male. Antennae with segments 8–12 transverse, 13 three times as long as broad, as long as 10 + 11 + 12. Ocelli separated from eyes by more than their diameter. Clypeus with no small teeth outside the two central ones which are stronger and more widely separated. Tubercles of propodeum very strong. Seventh tergite keeled, the keel projecting as a hook. Third sternite discally depressed, apex callose on each side. Inner ventral edge of hind trochanter with a fine keel.

Specimens examined: 7 ♀♀, Texas (L.); ♀, Vernon, N. Carolina, 25 July '02 (L.); ♀, Claremont, California (det. Bradley) (L.); ♀, Dallas, Texas (*Boll*) (B.); ♂, N. America (B.); 2 ♀♀, N. Sonora, Mexico (*Morrison*) (B.C.A.); ♀, S. José de Guaymas, Mexico, 10 April (*L. O. Howard*) (W.); ♂, Guaymas, Sonora, Mexico, 29 Sept. '23 (*W. M. Mann*) (W.).

T. texense Saussure (1867).

(= *T. relativum* Rohwer (1909); *T. sulcus* La Munyon (1877)).

Female. Black, mandibles except tip, tegulae, antennal segments 1–4 (more or less), apex of clypeus, pronotal tubercles, all tibiae and tarsi, narrow apex to pitchy femora, abdominal segments 1–2 and sides and narrow apex of remaining tergites, reddish. Wings pale fuscous, darker along costa and at apex. Pubescence light brassy, distinctly dense, noticeably so on dorsal area of propodeum. Length 16–18 mm.

Occiput shining, with close fine punctures. Eyes equally separated above and below, on occiput by a little more than length of antennal segments 2 + 3. Ocelli separated by three-quarters their diameter or more from eyes, by the same distance from one another. Vertex shining, with close, large, shallow punctures, no central impression. Supraantennal keel weak with a small truncation behind. Limiting keels of antennal scrobes little developed. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 nearly six times as long as broad, shorter than 4 + 5, 4 as long as 5, two and two-thirds times as long as broad, remaining segments all longer than broad, 12 about twice as long as broad. Clypeus with a very short keel just before apex, margin with two rather widely separated teeth, outside each of which is a small emargination (teeth often very weak). Occipital keel incomplete, horizontal space behind buccal cavity moderately broad. Tempora beneath shining, sparsely and moderately strongly punctured. Stipes of maxillae shining, sparsely and finely punctured. Proepisternal keel sharp-edged but without teeth. Mesopleuron shining, sparsely but rather strongly punctured. Pleural suture extending half-way up the pleuron. Mesonotum and scutellum shining, rather closely and finely punctured, the latter flat. Postnotum densely hairy, lateral lobes and depressions quite hidden. Metasternum with a narrow V-shaped furrow. Propodeum with dorsal surface depressed over a large central triangular area which is transversely striate, elsewhere dull and finely rugose, sides somewhat raised posteriorly. Posterior surface with a deep narrow furrow to orifice but shallowing out below, no keeled depression, angles with the keels obsolete, finely rugose. Sides dull, closely and finely punctured with obsolescent striae. First abdominal tergite with a furrow for half its length, spiracular area twice as long as broad, apophyses moderately developed, tergite at base as broad as length of hind trochanter, twice as broad at apex, not quite as long as hind femur + trochanter. Second tergite two-thirds as long as first, twice as long as broad at apex. First tergite moderately, second hardly contracted at apex. Sixth tergite keeled on apical third. Sternites bare. Hind trochanter simple or with a very weak tubercle.

Male. Antennae with segments 1–6 red, 7–13 becoming gradually darker, segment 13 nearly as long as 11 + 12. Apex of clypeus produced into a small rectangular plate which is shallowly emarginate and bears a small central tooth (*i.e.* margin weakly tridentate). Seventh tergite keeled, the keel projecting beyond the apex as a spine. Second tergite raised towards the apex, disc with a large subcircular depression. Hind trochanter with a long spine, hind femur weakly emarginate on basal half.

Specimens examined: ♀, Texas, Richmond, 29 May '18 (*J. Bradley*) (V.); 2 ♂♂, 1 ♀, Texas (L.); ♂♀, Texas (*Boll*) (B.); ♀, same data (V.); ♀, Lewisville, Arkansas, 25 June '18 (*J. C. Bradley*) (L.); ♀, Huntsville, Texas (*C. Hartmann*) (det. as *T. relativum* Roh. by Rohwer) (W.).

T. apicipenne Cameron (1889).

Female. Black, antennae with segments 3–5 above and 1–5 beneath, mandibles, tegulae, fore tibiae and tarsi, base of mid tibiae, mid and hind tarsi, dark reddish. Last segment of all tarsi dark with the claws testaceous. Wings hyaline with apex of both pairs fuscous. Pubescence very dense especially on propodeum, silvery. Length 21 mm.

Occiput rather strongly raised, little depressed in centre, very shining, hardly punctured. Eyes distinctly further apart at clypeus than on occiput, where separated by a distance rather less than length of antennal segment 3. Ocelli separated by rather less than half their diameter from eyes, by three-quarter diameters from one another. Vertex dull, moderately coarsely and very closely punctured, central impression weak. Supraantennal keel short, little raised, narrowly truncate posteriorly. Limiting keels of antennal scrobes strong, as long as scape of antennae. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times as long as broad, shorter than 4 + 5, 4 a little longer than 5, which is about two and a half times as long as broad, remaining segments all about twice as long as broad, 12 a little longer than 11. Clypeus obtusely keeled, with a moderately large central emargination and two small ones on each side of it. Occipital keel incomplete, horizontal space behind buccal cavity rather narrow. Tempora beneath with close, fine punctures. Stipes of maxillae almost unpunctured. Proepisternal keel sharp-edged, produced into a small tooth at centre. Mesopleuron shining, moderately sparsely and finely punctured. Pleural suture hardly developed. Mesonotum and scutellum closely and finely punctured, the latter flat. Metanotum nearly flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions shallow. Metasternum with a small V-shaped emargination. Propodeum with the dorsal surface strongly depressed over a triangular area on disc, which is faintly cross-striate. Posterior surface with a deep furrow to orifice, keeled depression weak, angles without keels, closely striate. Sides shining, closely and finely punctured. First abdominal tergite with a long furrow, spiracular area one and a third times longer than broad, apophyses obsolete, tergite rather wider at base than length of hind trochanter, one and a half times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as long as its width at apex. First and second tergites both strongly contracted at apex. Sixth tergite not keeled. Sternites bare.

Male. Antennae with segments 3–5 pale beneath only. Hind tarsi black, apical third of first segment and whole of second dirty white, third and fourth segments reddish. Wings more suffused with fuscous. Pubescence golden on face, silvery elsewhere. Vertex a little more finely punctured. Antennae with segments shorter, penultimate ones not much longer than broad, 13 as long as 11 + 12. Clypeus with apex weakly tridentate and a short keel extending up from central tooth. Ventral surface of hind trochanter with a keel, ending posteriorly in a small tubercle. Seventh tergite with a keel ending in a small projecting hook. Third sternite with a central depression defined at sides by slight prominences and by strong ones at apex, the apical prominences nearly meeting one another on mid line. Apical half of sternite 5 and whole of 6 and 7 with dense but short, white, outstanding hairs.

Specimens seen. Type. ♀, N. Yucatan (*Gaumer*) (B.C.A.). Also ♂, N. Yucatan (*Gaumer*) (B.C.A.) (identified by Cameron as *cinereum*).

T. bicalcaratum sp. n.

Male. Black, antennae with 1–7 and underside of 8–11, apex of clypeus, mandibles except tip, tegulae, lateral lobe of postnotum, sides of first abdominal tergite, whole of second segment, sides and narrow apex of remaining tergites, apex of fore trochanters, narrow base and apical quarter of fore femora, narrow apex of four hind femora, all tibiae, all tarsi except dark brown apical segment, reddish-brown. Wings pale yellow-brown darker at apex. Pubescence brassy, silvery on thoracic sternum and propodeum, very short and dense on mesonotum. Length 19 mm.

Occiput distinctly raised behind each lateral ocellus, shining, with sparse punctures. Eyes a little further apart at clypeus than on occiput where separated by about the length of antennal segment 3. Ocelli separated by rather less than half their diameter from eyes, by three-quarter diameters from one another. Vertex dull, finely but confluently and subrugosely punctured, central impression weak. Supraantennal keel short but distinct with a slight horseshoe-shaped truncation behind. Limiting keels of antennal scrobes strong, as long as scape of antennae. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as its greatest width, 3 five times as long as broad, hardly as long as 4 + 5, 4 hardly longer than 5, two and a quarter times as long as broad, remaining segments progressively shorter till 12 is quadrate, 13 as long as 11 + 12, two and a quarter times as long as broad. Clypeus with a small central keel on apical half, apex slightly produced over central third, the produced part biemarginate, leaving three teeth of which the central one is the largest. Occipital keel strong, not quite complete, horizontal space behind the buccal cavity narrow. Tempora beneath shining, moderately closely and finely punctured. Stipes of maxillae shining, finely and sparsely punctured. Proepisternal keel sharp-edged, produced into a small tooth at centre. Mesopleuron shining, moderately finely and sparsely punctured. Pleural suture hardly developed. Mesonotum and scutellum shining, closely and finely punctured, the latter flat. Metanotum flat, closely punctured, lateral lobes striate, posterior margin not hyaline, depressions large and shallow. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface strongly depressed over a triangular central area faintly cross-striate especially posteriorly, raised sides of the area almost forming definite prominences posteriorly. Posterior surface with a deep furrow to orifice, very broad and shallow for the lower third of its length, no keeled depression, angles without keels, regularly and rather finely striate. Sides shining, very finely and closely punctured. First abdominal tergite with a furrow for rather more than half its length, spiracular area rather longer than broad, apophyses very weak, tergite at base fully as broad as length of hind trochanter, one and two-thirds times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, twice as long as broad at apex. First and second tergites strongly contracted at apex. Seventh tergite keeled, the keel projecting at apex as a small hook. Sternites modified as in *T. apicipenne*, but outstanding pubescence of sternites 5–7 denser. Sternites 1–3 bare, 4 with scattered hairs on all its surface. Hind trochanter with a strong lamelliform spine as in *T. apicipenne* but stronger. Mid trochanter with a rounded swelling ventrally just before apex.

Type. ♂, Mexico (W.).

This specimen may be no more than an aberration of *T. apicipenne*, but in view of the differences it is better kept apart till more material is available.

T. nattereri sp. n.

Female. Black, mandibles, tegulae, base of tibiae narrowly and sides of first abdominal tergite piceous. Basal half of second abdominal tergite reddish-yellow. Wings hyaline, a little clouded in radial cell and at apex. Pubescence pale silvery-brassy, very dense on the usual areas, including the whole propodeum except the ventral part of the sides. Length 13 mm.

Occiput flat, finely and closely punctured in centre, sparsely punctured at sides. Eyes distinctly closer at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by nearly two-thirds their diameter from eyes, by their diameter from one another. Vertex dull, finely coriaceous, with sparse, shallow, flat-bottomed punctures visible under a high magnification; central impression strong. Supraantennal keel weak, truncate in the form of a horseshoe behind. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by their diameter. Antennae with scape somewhat longer than greatest breadth, 3 five times as long as broad, nearly as long as 4 + 5, 4 a little longer than 5, three times as long as broad, remaining segments all longer than broad, 12 one and a half times as long as 11, twice as long as broad. Clypeus with a small trapezoidal central projection whose apex is shallowly emarginate, the projection itself defined on each side by a small emargination. Occipital keel incomplete, horizontal space behind the buccal cavity broad. Tempora beneath shining, finely and moderately closely punctured. Stipes of maxillae shining, almost unpunctured. Proepisternal keel obsolete towards centre, where there is a weak tooth and with a strong lamelliform tooth at sides. Prepectus with a short but strong ventral keel. Mesopleuron shining, rather strongly and closely punctured. Pleural suture extending about one-quarter of the way up the pleuron. Mesonotum and scutellum rather strongly and closely punctured, the former more finely on disc, the latter flat. Postnotum flat, finely punctured, lateral lobes densely hairy, posterior margin not hyaline, depressions shallow. Metasternum with a narrow, parallel-sided emargination. Propodeum with dorsal surface depressed over a central triangular area which is dull and finely cross-striate. Posterior surface with a rather narrow furrow, shallowing out below, a large but ill-defined keeled depression, angles without keels, dull and finely and irregularly striate. Sides rather dull, finely and subobsoletely striate and finely and rather closely punctured. First abdominal tergite with a furrow as far as the spiracles, spiracular area quadrate, apophyses obsolete, tergite at base as broad as length of hind trochanter, twice as broad at apex, as long as hind femur + trochanter. Second tergite a little longer than half the first, one and a half times as long as broad at apex. First tergite moderately, second little contracted at apex. Sixth tergite keeled on apical half. Sternites bare. Hind trochanter with no ventral tubercle.

Type. ♀, Brazil (*Natterer*) (V.). Paratype. ♀, Lima, Peru, Jan. '22 (*F. Jaffael*) (V.). In the absence of the male the position of this species is rather doubtful.

T. clavatum Say (1837).

(= *T. annulare* Dahlbom (1845).)

Female. Black; mandibles dark pitchy; tegulae, fore tibiae, base of mid and hind tibiae and sides of abdominal tergites 1–2, testaceous tinged; fore tarsi pale annulated; hind tarsi with apical third of basitarsus and segments 2–4 whitish-yellow. Wings hyaline with the apex clouded. Pubescence silvery. Length 13 mm.

Occiput rather strongly raised behind each lateral ocellus, smooth and unpunctured even in the central depression. Eyes equally separated at clypeus and on occiput, on the latter by a distance equal to the length of antennal segments 2 + 3. Ocelli separated by from one-third to one-half their diameter from eyes, by nearly their diameter from one another. Vertex not very shining, with large, subconfluent punctures, central impression weak. Supraantennal keel little raised, with a fine keel and a small posterior truncation. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by their diameter. Antennae with scape one and a third times as long as its greatest width, 3 five times as long as broad, not as long as 4 + 5, 4 a little longer than 5, about three times as long as broad, remaining segments all about one and a half times as long as broad, 12 nearly twice as long as 11. Clypeus with a small apical emargination. Occipital keel incomplete, horizontal space behind buccal cavity narrow. Tempora beneath shining, finely and sparsely punctured. Stipes of maxillae shining, rather strongly punctured. Proepisternal keel strong and sharp-edged but not produced into teeth. Mesopleuron shining, strongly and rather closely punctured. Pleural suture extending nearly half-way up the pleuron. Mesonotum and scutellum moderately strongly and closely punctured, the disc of the former more sparsely, the scutellum flat. Metanotum flat, finely and sparsely punctured, lateral lobes striate, posterior margin not hyaline, depressions shallow. Metasternum with a large U-shaped emargination. Propodeum with dorsal surface not much depressed with strong striae which are diagonal anteriorly and transverse behind. Posterior surface with a deep narrow furrow which shallows out before the strong keeled depression, angles without keels, strongly and irregularly striate. Sides rather closely and finely punctured, more finely anteroventrally. First abdominal tergite with no furrow, spiracular area one and two-thirds times as long as broad, apophyses rather strong, tergite at base not quite as broad as length of hind trochanter, nearly twice as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as long as broad at apex. First tergite very strongly, second moderately contracted at apex. Sixth tergite not keeled. Sternites bare. Hind trochanter with a small tubercle before the apex.

Male. Antennae with segments shorter, 13 thick, little tapering, nearly as long as 10 + 11 + 12. Clypeus more broadly emarginate at apex, emargination with a weak central tooth. Seventh tergite with a keel projecting beyond the apex as a small hook. Sternites nearly simple, third a little prominent at apex. Hind trochanter with a strong ventral spine, hind femur with a weak emargination on basal half.

Specimens examined: 2 ♀♀, Warm Springs, N. Carolina (*E. Doubleday*) (L.); ♂, Carolina (*Zimmermann*) (B.); ♀, Delaware, Smith coll. (L.); 3 ♀♀, N. America (L.); ♂♀, Billy's Island, Okefenokee Swamp, Georgia, June '12 (det. Bradley) (L.); ♀, Georgia (B.); ♂, Wilmerding, Pennsylvania (*Zahrobsky*) (L.); ♀, Dallas, Texas (*Boll*) (B.); ♂, " Savannah " (*Harper*) (P.).

var. *cockerellae* Rohwer (1909).

Structurally similar, but differs as follows in colour:—Abdomen with sides of first tergite, narrow apex of first tergite and sternite, and basal three-quarters of second segment, red. Fourth segment of hind tarsi dark.

Specimen examined: ♀, St. Louis, Missouri, 29 July '09, no. 1001 coll. (*P. Rau*) (W.) (Homotype).

Dr. Bengtsson kindly reported on the type of *T. annulare*, and I have little doubt that it is the same as *T. clavatum* Say. The locality " S. America " given by Dahlbom must be incorrect.

T. johannis sp. n.

Female. Black, antennae with segments 1–6 and base of 7, apex of clypeus, mandibles, palpi, pronotum, anterior part of proepisternum, anterior half of dorsal surface of propodeum, legs except base of four hind coxae, metasternum and first two abdominal segments, reddish-testaceous. Wings light fuscous, more hyaline towards the base. Pubescence silvery, not very dense. Length 15 mm.

Occiput somewhat raised behind the lateral ocelli, shining, with sparse punctures. Eyes equally separated above and below, on occiput by a distance equal to the length of antennal segments 2 + 3. Ocelli separated by two-thirds their diameter from eyes, by their diameter from one another. Vertex moderately shining, with confluent, large, shallow punctures (finer near ocelli) and a rather deep central impression. Supraantennal keel little raised, narrowly truncated posteriorly. Limiting keels of antennal scrobes rather weak, as long as diameter of antennal sockets. Antennal sockets separated by their diameter. Antennae with scape hardly longer than its greatest width, 3 five times as long as broad, a little shorter than 4 + 5, 4 as long as 5, two and a third times longer than broad, remaining segments all longer than broad, 12 two and a half times as long as broad, shorter than 11 + 12. Clypeus a little produced over central half, weakly emarginate. Occipital keel incomplete, horizontal space behind buccal cavity rather narrow. Tempora beneath shining, strongly and sparsely punctured. Stipes of maxillae shining, closely and moderately strongly punctured. Proepisternal keel moderately sharp-edged but hardly produced into a tooth even in the centre. Mesopleuron shining, strongly and closely punctured, the punctures separated by about twice their diameter. Pleural suture extending nearly half-way up the pleuron. Mesonotum and scutellum shining, strongly and closely punctured, the latter flat. Metanotum flat, finely punctured, lateral lobes and depressions hidden by dense pubescence. Metasternum with a small V-shaped emargination. Propodeum with dorsal surface a little depressed over a central triangular area, with coarse striae, diagonal at base and transverse at apex, rather dull, the depressed triangle defined by coriaceous lateral areas. Posterior surface with a deep narrow furrow to orifice, a deep, well-defined keeled depression, angles with keels subobsolete, strongly clathrate. Sides moderately shining, closely punctate-striate. First abdominal tergite with a furrow for half its length, spiracular area twice as long as broad, apophyses rather strong, tergite at base a little narrower than the length of the hind trochanter, two and a half times as broad at apex, a little longer than hind femur + trochanter. Second tergite two-thirds the length of first, one and a half times as long as broad at apex. First tergite strongly, second moderately contracted at apex. Sixth tergite missing. Sternites bare. Hind trochanter with a slight ventral tubercle.

Male. Antennae with segments 1–9 and the base of 10 red. Metasternum and an anterior streak on hind femora black. Apex of second abdominal tergite indeterminately darker. Central impression of vertex hardly developed. Antennae with 9–11 quadrate, 12 transverse, 13 two and two-thirds times as long as broad, nearly as long as 10 + 11 + 12. Clypeus with a moderately strong emargination on central third, defined by small teeth at sides and with a small tooth in centre. Keeled depression hardly developed on posterior surface of propodeum. Spiracular area of first abdominal tergite one and a half times as long as broad. Tergite 7 keeled, the keel projecting as a small hook. Third sternite depressed at base, raised and thickened at apex. Hind trochanter with a strong, blunt, ventral spine; hind femur weakly emarginate at base, posteriorly with long hairs.

Type. ♂, St. John's Bluff, E. Florida (*E. Doubleday*) (L.). Allotype. ♀, with the same data; ♀, no locality (O.). The species was included under the material from which F. Smith described his *T. collinum* (q.v.). These two species, though exceedingly similar in colour pattern, belong to quite different groups.

T. campaspe sp. n.

Female. Black, antennae with segments 3–5 obscurely red at apex, apex of clypeus and mandibles pitchy red; tegulae testaceous; abdomen with first segment except base, second segment and base of third, bright red. Wings hyaline with costal half of radial cell and apex fuscous. Pubescence silvery. Length 15 mm.

Occiput a little raised, smooth and shining, sparsely punctured in the central depression. Eyes slightly closer at clypeus than on occiput, where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by two-thirds their diameter from eyes, by one and a half times their diameter from one another. Vertex shining, coarsely and moderately closely punctured, with a strong central depression; in the region of the ocelli more sparsely and not strongly punctured. Supraantennal keel strong, bearing a fine keel with a distinct narrow truncation behind. Limiting keels of antennal scrobes distinct, as long as scape of antennae. Antennal sockets separated by their diameter. Antennae with scape hardly longer than its greatest width, 3 three and a half times as long as broad, a little shorter than 4 + 5, 4 hardly longer than 5, 5 two and a quarter times longer than broad, remaining segments progressively shorter till 11 is just longer than quadrate, 12 one and two-thirds times as long as 11, about twice as long as broad. Clypeus with a slight central keel on its apical third, apex polished with a shallow central emargination. Occipital keel just incomplete, horizontal space behind buccal cavity moderately broad. Tempora beneath sparsely and rather finely punctured. Stipes of maxillae finely and rather closely punctured. Proepisternal keel strong but not produced into teeth. Mesopleuron shining, moderately strongly and closely punctured. Pleural suture extending nearly half-way up the pleuron. Mesonotum and scutellum shining, rather finely and closely punctured, the latter flat. Metanotum flat, finely punctured, lateral lobes striate with no hyaline posterior margin, depressions large and shallow. Metasternum with a narrow but deep emargination. Propodeum with dorsal surface with sides raised and smooth, disc depressed, shining, finely cross-striate. Posterior surface with a deep furrow, shallowing out below, no keeled depression, angles without keels, rather closely and regularly striate. Sides practically impunctate and smooth. First abdominal tergite with a weak furrow for half its length, spiracular area one and two-thirds times as long as broad, apophyses hardly developed, tergite at base nearly as broad as length of hind trochanter, two and a third times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as the first, two and a third times as long as broad at apex. First tergite very strongly, second rather strongly contracted at apex. Sixth tergite hardly keeled. Sternites bare. Hind trochanter with a distinct tubercle just before the apex.

Type. ♀, Nogales, Mexico, 8 Aug. '19, no. 44760 (*F. J. Dyer*) (W.).

T. arizonense Fox (1891).

Female. Black, mandibles, tegulae testaceous. Abdominal segments 1–3 red with basal half of first tergite and apical half of third (irregularly) black. Pubescence silvery, short and dense. Wings hyaline, apex and the costal half of radial cell clouded. Length 13 mm.

Occiput little raised, shining, faintly alutaceous, sparsely punctured. Eyes distinctly closer together on clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by half their diameter from eyes, by nearly their diameter from one another. Vertex a little shining, coarsely and confluently but shallowly punctured, central impression weak. Supraantennal keel fine, not truncate behind. Limiting keels of antennal scrobes not developed. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest breadth, 3 about four times as long as broad, about as long as 4 + 5 (apex of antennae missing). Clypeus with a rather strong central, rounded emargination and a very small one on each side of it. Occipital keel strong, incomplete, horizontal space behind the buccal cavity narrow. Tempora beneath shining, with sparse fine punctures. Stipes of maxillae shining, closely and finely punctured. Proepisternal keel sharp-edged forming a small tooth at centre. Mesopleuron shining, moderately closely and strongly punctured. Pleural suture hardly developed. Mesonotum and scutellum not very closely or strongly punctured, shining, the latter flat. Metanotum not very convex, densely hairy, lateral lobes without a raised hyaline margin, depressions elongate, shallow. Metasternum with a V-shaped emargination. Propodeum with dorsal surface rather strongly depressed over a central triangular area which is shining, finely transversely striate. Posterior surface with a moderately deep furrow extending to orifice but becoming shallow and ill-defined below, no keeled depression, angles with keels obsolete, finely rugose below, striate above. Sides shining, finely and closely punctured. First abdominal tergite with a furrow on its basal half, spiracular area nearly twice as long as broad, apophyses moderately strong, tergite as wide at base as length of hind trochanter, two and a half times as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, twice as long as wide at apex. First tergite strongly, second moderately contracted at apex. Sixth tergite hardly keeled at apex. Sternites bare. Hind trochanter with a rudimentary tubercle at apex.

Male. Legs with narrow base to fore femora, very narrow apex to all femora and annulations of hind tarsi testaceous. First three abdominal segments entirely red. Antennae with segments 4 and 5 subequal about twice as long as broad, remaining segments progressively shorter, penultimate ones about quadrate, 13 two and a third times as long as broad, about as long as 12 + 11 + 10. Clypeus with three small apical teeth, together including about one-third of apical margin. Mesonotum rather less strongly punctured. Hind trochanter with a strong spine, hind femora weakly emarginate beneath on basal half which, posteriorly, bears rather long, white hairs. Third abdominal sternite depressed on disc basally, thickened on each side near apex, fourth somewhat thickened transversely at apex. Seventh tergite keeled, keel projecting as a small hook at apex.

Specimens examined : ♀, California, Calaveras Co., 10 July (*W. M. Giffard*) (W.) (det. Rohwer); ♂, Arizona (*C. F. Baker*) (W.); ♂, California (*Müller*) (B.); ♂, Mexico, State of Coahuila (*C. A. Purpus*) (B.).

T. fusciventre Cameron (1889).

This form appears to be scarcely distinct from *T. arizonense* Fox except in colour.

Female. Black, antennae pale tinged especially towards the apex; mandibles and tegulae pitchy; first abdominal segment except base of tergite, and whole of rest of abdomen, fore tibiae and tarsi, base of four pairs of hind tibiae narrowly, indeterminately reddish. Hind tarsi with segments 2–4 reddish-white. Wings pale fuscous. Pubescence silvery-brassy, not very dense. Length 12 mm.

Punctures of vertex coarser than in *T. arizonense.* Limiting keels distinct.

Specimens examined: Type. ♀, Yucatan (*Gaumer*) (B.C.A.) and another female with the same data. Both are in bad condition and the status of the species must be regarded as doubtful.

T. sonorense Cameron (1889).

This form also appears to be scarcely more than a variant of *T. arizonense.*

Female. Black, mandibles and tegulae piceous; first two abdominal segments red except for large basal area of first tergite, third segment narrowly red basally. Wings hyaline with costal half of radial cell and apex darker. Pubescence silvery, only moderately dense. Length 14 mm.

Mesonotum and mesopleuron more strongly punctured than in *T. arizonense.*

Specimens examined: Type. ♀, N. Sonora, Mexico (*Morrison*) (B.C.A.); 2 ♀♀, 1 ♂, with same data (B.C.A.); 2 ♀♀, 'Lerdo Dgo,' Mexico, 12 May '17 (W.); ♂, S. José de Guaymas, Mexico, 10 April (*L. O. Howard*) (W.). In the last named specimen the ocelli are separated by nearly two-thirds their diameter from the eyes.

T. salti sp. n.

Female. Black, a small spot on mandibles, tegulae, a narrow base to the tibiae, sides and apex of first abdominal segment, base of second, reddish. Wings fusco-hyaline, darker along costa and at apex. Pubescence light brassy, very dense, especially on the propodeum of which the dorsal surface is quite hidden. Length 12–14 mm.

Occiput a little raised behind the ocelli, shining, finely punctured. Eyes a little closer at clypeus than on occiput, where separated by the length of segments 2 + 3 of antennae. Ocelli separated by rather less than half their diameter from eyes, by two-thirds their diameter from one another. Vertex shining, coarsely and confluently punctured, central impression weak. Supraantennal keel little raised, with fine keel and a weak truncation. Limiting keels of antennal scrobes distinct, enclosing a quadrate area. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 four and a half times as long as broad, nearly as long as 4 + 5, 4 as long as 5, two and a half times as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad. Clypeus with a small keel on apical half, with a small central emargination and a smaller one on each side of it, sometimes only simply emarginate. Occipital keel not quite complete, horizontal space behind buccal cavity narrow. Tempora beneath shining, sparsely and finely punctured. Stipes of maxillae finely and sparsely punctured. Proepisternal keel moderately strong, sinuate, not or hardly produced into teeth. Mesopleuron moderately finely and sparsely punctured. Pleural suture usually extending nearly half-way up the pleuron. Mesonotum and scutellum shining, rather closely and finely punctured, the latter flat. Metanotum flat, densely pubescent, lateral lobes striate, posterior margin not hyaline, depression weak. Metasternum with a narrow

V-shaped emargination. Propodeum with the dorsal surface a little depressed, finely punctate-striate, but surface more or less hidden by the pubescence which defines the area by its direction. Posterior surface with a narrow furrow becoming very shallow below, no keeled depression, angles with no keels, finely striate. Sides finely and closely punctured. First abdominal tergite with a furrow as far as the spiracles, spiracular area a little longer than broad, apophyses little developed, tergite at base as wide as length of hind trochanter, nearly twice as wide at apex, not quite as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as long as wide at apex. First tergite distinctly, second little contracted at apex. Sixth tergite not keeled. Sternites bare. Hind trochanter with a small ventral tubercle.

Male. Antennae with apex of segment 2 and often 3–5 somewhat reddish tinged. Ocelli sometimes separated by only one-third their diameter from eyes. Antennae with 4 and 5 only twice as long as broad, 13 two and a half times as long as broad, as long as 11 + 12. Clypeus at apex tridentate, central tooth often weak. Seventh tergite keeled, the keel projecting as a small hook. Third sternite strongly depressed at base. Hind trochanter with a strong ventral spine, hind femora weakly emarginate on basal half and here posteriorly with long white hairs.

Type. ♀, Colombia, Rio Frio, Magdalena, 6 July '27 (*Salt*), building nest in knot-hole in window-sill. Allotype. ♂, the same place, 1 Jan. '27. Paratypes. *Mexico:* 2 ♂♂, 1 ♀ (*C. F. Baker*) (W.); ♂ (L.); ♂♀, Tierra Colorada, Guerrero, 2000 ft. (*H. H. Smith*) (B.C.A.); 5 ♂♂, 1 ♀, Orizaba, '62 (*Biart*) (P.); ♂, State of Colima (*L. Conradt*) (W.). *Guatemala:* 4 ♂♂, Cayuga, April–June (*W. Schaus*) (W.). *Honduras:* 2 ♂♂, 1 ♀, La Ceiba, ♂♂ 26 Dec. '15, ♀ 1 April '16 (*F. J. Dyer*) (W.); 2 ♀♀, Carmelina (*W. M. Mann*) (W.); ♂, 2 ♀♀, Lombardia (*W. M. Mann*) (W.). *Nicaragua:* ♂, 5 ♀♀, S. Antonio, May '99 (W.); ♀, Bluefields (*F. Schramm*) (B.). *Panama:* ♂, Portobello, 24 Feb. '11 (*E. A. Schwarz*) (W.); ♀, Punta de Peña, 4 Aug. '05 (*R. E. B. McKenney*) (W.); 2 ♀♀, Paraiso, 8 Feb. '11 (*A. Busck*) (W.); 2 ♂♂, Limon, Chagres River, 14 Oct. '18 (*Dietz* and *Zetek*) (W.); 2 ♂♂, Tabernilla, 21 June and 24 July '07 (*A. Busck*) (W.); ♂, Las Cruces, 4 Feb. '11 (*A. Busck*) (W.); ♂, Tobago Is., 13 June '11 (W.); ♂, Tobago Is., 10 June '11 (*A. Busck*) (W.); ♂♀, Gamboa, 31 Aug. '18, G. 206 (*H. F. Dietz*) (W.); ♂, Ancon, 12 Aug. '18 (*H. F. Dietz*) (W.); ♂, Ancon (*A. H. Jennings*) (W.); ♀, Close's Saddle, Cano, July '23 (*M. F. Close*) (W.). *Colombia:* ♂, 2 ♀♀, Rio Magdalena, Baranquilla to El Banco, June–July '24 (*C. Allen*) (L.); ♂♀, Rio Frio, Magdalena, 18 April, '27 (*Salt*); ♂♀, Sevilla, Magdalena, 2 Aug. '27 (*Salt*); ♂, Santa Marta, May '13 (*J. H. Egbert*) (W.); ♀, Popayan, '00 (V.); ♂, S. Lucas (*M. Valerio*) (W.); ♂, Cauca (B.); 2 ♂♂, 1 ♀, 1830, Le Bas (P.); ♂, 3 ♀♀, Bogota (P.). *Ecuador:* 10 ♂♂, 3 ♀♀, Guayaquil, April '01 (*Buchwald*) (V.): ♂ (*C. F. Baker*) (W.); 5 ♂♂, Guayaquil (P.).

None of these specimens, even in the males, has the hind tarsi definitely white marked, though a few of that sex have a tinge of a lighter brown on the intermediate segments. For a discussion of the status of this species see under *T. spinosum* Cam.

T. spinosum Cameron (1889) ♂.

(= *T. cinereohirtum* Cameron (1889) ♀).

Very close to *T. salti* sp.n., but differs as follows:—Hind tarsi with segments 2–3 and often part of 4, whitish-yellow. Pubescence silvery, not very dense, dorsal surface of propodeum well exposed. Limiting keels of antennal scrobes usually shorter. Mesopleuron and especially mesonotum more strongly and closely punctured.

The following specimens agree with the above diagnosis :—*Mexico :* Type. ♂, Presidio (*Forrer*) (B.C.A.); 10 ♂♂ with the same data; ♀, Acapulco, Guerrero, Sept. (*H. H. Smith*) (B.C.A.); ♂, Rincon, Guerrero, 2800 ft., Sept. (*H. H. Smith*) (B.C.A.); ♀, Acaguizotla, Guerrero, 3500 ft. (*H. H. Smith*) (B.C.A.); 5 ♂♂, 2 ♀♀, N. Yucatan (*Gaumer*) (B.C.A.); ♂, Tierra Colorada, Guerrero, 2000 ft. (*H. H. Smith*) (B.C.A.); ♀, Ventanas, 200 ft. (*Forrer*) (B.C.A.); ♀, Vera Cruz, Jan. '88 (*H. H. Smith*) (B.C.A.); ♂, Ciudad, Lower California, 8000 ft. (*Forrer*) (B.); ♀, Orizaba, '62 (*Biart*) (P.); ♂♀, State Puebla, Tehuacan, '03 (*L. Diguet*) (P.); 8 ♂♂, 6 ♀♀, State of Jalisco, near Guadalajara (*L. Diguet*) (P.); ♀, West Coast, '64 (*Biart*) (P.); 2 ♂♂, State of Colima (*L. Conradt*) (W.); ♂, Etla, Oaxaca, Sept. '23 (*E. G. Smyth*) (W.). *Guatemala :* ♀, S. Geronimo (*Champion*) (type of *T. cinereohirtum* Cam.) (B.C.A.); ♀, Guatemala City (*Champion*) (B.C.A.); ♀ El Ranchó, 900 ft., 17 Feb. '32 (*C. N. Ainslie*) (W.); ♀, Cayuga, Jan. (*Schaus* and *Barber*) (W.); 3 ♂♂, Angrand (P.). *Honduras :* ♀, Tegucigalpa, 2 Sept. '18 (*F. J. Dyer*) (W.).

The following specimens are more or less intermediate between *T. spinosum* and *T. salti.* It may be taken that the characters are those of *T. spinosum* except where otherwise stated.

Punctuation weaker. ♂, Panama, Paraiso, 300 ft. (*Champion*) (B.C.A.).

Punctuation intermediate; hind tarsi dark. 2 ♂♂, 2 ♀♀, Mexico, Teapa, Tabasco (*H. H. Smith*) (B.C.A.).

Punctuation and hind tarsi as in *T. salti.* ♀, Mexico (P.).

Punctuation and pubescence intermediate. ♂, Honduras, Lombardia (*W. M. Mann*) (W.).

Punctuation and hind tarsi as in *T. salti.* Pubescence intermediate, but more like *T. spinosum.* Further the vertex unusually finely punctured. ♂, Mexico, La Paz, Lower California, '14 (*L. Diguet*) (P.).

I have treated all these variants as belonging to *T. spinosum*, but the decision is arbitrary.

It appears to me that the present resources of entomological nomenclature are insufficient to deal with a group of forms such as *T. salti, T. armatum* and *T. spinosum. T. armatum* appears to be the most distinct, but this may be only because the material available is at present rather scanty.

As regards the other pair, they are not what may be called " good " species, because their characters intergrade; they are not geographical races, because the overlap of range is too great and because the intermediates are not confined to the zone where the two forms meet; nor are they varieties in the ordinary sense of the term, since in a large part of their range each form seems to maintain a homogeneous population.

I think it will have to be recognised that geographical segregation in insects is often of a different nature to the more familiar process observable in birds and mammals. Insects often form more or less geographically segregated units, but these are often more connected with intermediates which are scattered over a much larger part of the range of each main form. It appears probable that in insects non-geographical forms of isolation are far more effective than they are in birds and mammals, and that in consequence more overlapping may (in some species) take place without much interbreeding. Parallel cases are known in the SPHECIDAE (*Chlorion, Sceliphron*; Fernald, 1907, Porter, 1926) and in the VESPIDAE (Bequaert, 1919, 1931). Bequaert solves the difficulty by using the term variety in a non-committal sense, but it seems to me that this treatment tends to obscure the extent to which geographical segregation of variants actually exists.

It is possible that *T. lactitarse* Saussure (1867, p. 73), described from Mexico, is an earlier name for this species.

T. armatum Taschenberg (1875).

Very close to *T. salti* sp. n. and to *T. spinosum* Cam. Differs from the former as follows:—Legs entirely black with segments 2–3 (in male also apex of 1) of hind tarsi white; abdominal markings brighter red. Pubescence silvery (brassy on the face of the male) quite sparse, particularly on the propodeum, where the regular, rather widely spaced striae of the angles are well visible. Dorsal surface of propodeum almost bare, only relatively sparse pubescence developed, the surface with strong transverse striae. Mesothorax rather finely and very sparsely punctured. Sides of propodeum very shining, very sparsely and obsoletely punctured. Limiting keels of antennal scrobes obsolete. Central tooth of proepisternal keel stronger.

Specimens examined: Type. ♂, Venezuela (H.). Other specimens. *Colombia:* ♂♀, Rio Frio, Magdalena, ♂ 15 Oct. '27, ♀ 18 July '27 (*Salt*); ♂, Mamatoco, Magdalena, 1 March '27 (*Salt*); 2 ♂♂, Lake Sapatoza region, Chiriguana district, Aug.–Nov. '24 (*C. Allen*) (L.). *Venezuela:* ♂, State of Zamora, Puerto Nutrias, '23, Mayeul Grisol (P.); ♂, Caracas (*Moritz*) (B.).

The present species has the colouring and pubescence of *T. spinosum* and the punctuation of *T. salti*. Actually the pubescence is sparser than in the former and the punctures are finer than in the latter species, especially on the propodeum. The range overlaps that of *T. salti* (from which it is easily separated) and is at present quite discontinuous with that of *T. spinosum*.

GROUP OF *T. PUNCTULATUM* TASCHBG.

Antennal sockets separated by from $\frac{1}{2}$ to $\frac{2}{3}$ the diameter of a socket. Limiting keels of antennal scrobes parallel, enclosing an area which is about quadrate. Clypeus with the apex emarginate or toothed (usually not very strongly), with never more than sparse outstanding hairs, height somewhat greater than the least width between the eyes below. Mandibles simple. Occipital keels incomplete, horizontal space behind the buccal cavity distinct. Lateral tubercles of pronotum elongate, moderate or strong. Angles of pronotal collar often with a trace of a border, especially below. Proepisternal keel strong, more or less toothed. Prepectus with or without a dorsal furrow, ventral furrow strong. Mesopleural suture developed or not. Furrow in front of mid coxae strong, crossed by a few striae. Metapleural keel strongly curved, area defined. Lateral lobes of postnotum raised into low lamellae with the edges hyaline and downcurved. Furrow joining depressions in the metapleural-propodeal suture usually rather weak and not crenate. Dorsal margin of orifice of propodeum broad, strongly sloping in towards the orifice which is usually considerably broader than high. Fore coxae without bristles at the apex in the female, keels of variable strength, converging. Mid coxae with the keel becoming stronger towards the apex, situate a little inwards from the outer margin. Hind coxae with inner dorsal keel moderately strong, proceeding most the way towards the apex, situate on the inner margin of the coxa. Fore-wings with the costa not produced beyond the radial cell, last section of M_{3+4} and im_1 set at an angle of about 135°, last section of M_{1+2} one to two and two-thirds times the penultimate. Two groups of hamuli on the hind-wings consisting of 6–7 and 6–9 hooks each, separated by $\frac{1}{2}$–1 times the length of the apical group. Sternites 2–5 with only a few hairs round the bases of the bristles, of which there are usually two or more on each side of sternites 3–5 (at least). Male seventh tergite usually with an apical keel projecting as a hook. Eighth sternite of male (Pl. VI, fig. 2) produced at apex into two long prongs. Male genitalia with the stipes and squama completely fused, very long and narrow; volsellae fused with one another for most of their length with a narrow emargination separating them at the apex, no basal lobe but with a large lateral lamella in the dorso-ventral plane; sagittae long, moderately broad, bent ventrally near base, apex expanded in the dorso-ventral plane, bearing dorsally a mushroom-shaped process (Pl. VIII, figs. 1 and 2).

Size moderate to large, wings more or less darkened (less so than in the group of *T. albitarse* F.), body entirely black, except that the hind tarsi have the apex of the first segment, the whole of segments 2–4 and sometimes segment 5, white. The group is found throughout America.

T. punctulatum Taschenberg (1875).

Female. Black, mandibles, palpi and tegulae pitchy testaceous, hind tarsi white except the last segment and the basal third of the first. Wings evenly moderately dark brown. Pubescence white, rather sparse. Length 16 mm.

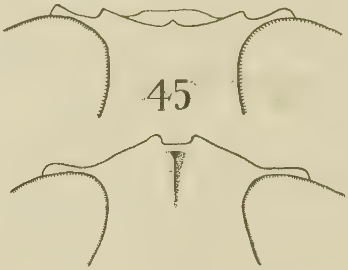
Occiput shining, finely punctured. Eyes about equally separated at clypeus and on occiput where separated by a distance equal to segments 2 + 3 of antennae. Ocelli separated by their diameter from eyes, by the same distance from each other. Vertex dull with very close large, flat-bottomed punctures, interstices alutaceous; feebly impressed longitudinally. Supraantennal keel short but strong and fine, not truncate behind. Limiting keels of antennal scrobes weak, enclosing an area one and a half times broader than long. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest breadth, 3 five times as long as broad, as long as 4 + 5, 4 hardly shorter than 5, two and a half times as long as broad, 6–11 progressively shorter, 11 about one and a third times as long as broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus not produced, a faint keel on apical half, a slight transverse impression before apex, beyond this smooth and a little upturned; apical margin with two very blunt central teeth and a minute emargination laterally to them. Clypeus without outstanding bristles, its central length one-third as long as least width between the eyes. Occipital keels incomplete, horizontal space behind the buccal cavity distinct. Tempora beneath closely and moderately strongly punctured, dull. Stipes of maxillae shining, finely punctured. Proepisternal keel distinct but produced into an obtuse lobe at sides only. Pronotal collar with angles moderately prominent, not bordered. Lateral tubercles of pronotum not very strong, sharp-edged. Prepectus with short dorsal keel, half crossing it, and a short ventral one, rather more closely punctured than the closely and strongly punctured mesopectus. Mesosternum closely and strongly punctured, dull. Pleural suture weak, proceeding half-way up pleuron. Mesonotum densely (punctures separated by their diameter) and strongly punctured, dull and alutaceous in front, more shining behind. Scutellum flat, more shining and much more sparsely punctured than the mesonotum. Metasternum with a broad shallow emargination. Propodeum with dorsal surface flat, closely and rather strongly punctured and, on the central triangle rather obsoletely striate, posterior surface with a deep furrow just continuous with a deep keeled depression, angles with very short keels enclosing an area twice as broad as high, angles with cross-striae which are strongly and widely spaced below and weaker and closer with flat interstices above, sides shining, closely and rather finely punctured. Hind tibiae rounded. First abdominal tergite with no furrow, spiracles not projecting, spiracular area about quadrate, basal apophyses weak and rounded. First tergite at base about as broad as length of hind trochanter, two and a half times as broad at apex, a little longer than the hind femur and trochanter together, second tergite hardly longer than half the first, one and a third times as long as broad at the apex, first rather strongly, second scarcely contracted apically, second a little at base. Sixth tergite carinate on apical quarter.

Specimens seen : Taschenberg's type, a female labelled Nov. Frib., Brasil (H.). Also one female Paraguay, Alto Parana, Puerto Bertoni, Jan. '09 (B.).

T. rogenhoferi Kohl (1883).

Similar to *T. punctulatum* Taschbg. except :—Length 16–18 mm. Supraantennal keel weaker. Clypeus in the male (fig. 45) with a shallow apical emargination, defined laterally by small teeth, covering two-thirds of its width, centre of apical margin produced into a small outstanding tooth beneath which is an area at a lower level, the area three times as broad as high. In the female the clypeus (fig. 46) has a more or less distinct central keel on apical half and apical margin is narrowly emarginate in centre with two much smaller emarginations on each side of it. Proepisternum with a sharper-edged keel which forms an obtuse tooth at centre. Whole thorax much more finely and sparsely punctured. Pleural suture short, proceeding one-third to one-quarter of the way up the pleuron. Propodeum less punctured dorsally, furrow of posterior surface subcircular separated by its own length from the keeled depression.

In the male the thirteenth antennal segment is about twice as long as broad and the seventh tergite is keeled, the keel projecting as a hook.



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FIGS. 45–46.—(45) Antero-dorsal view of clypeus of *T. rogenhoferi* Kohl, male. (46) The same, female.

Specimens seen : Specimens determined by Kohl as his *T. rogenhoferi* belong both to the present species and to *T. cinereum* Cam. I have not seen the type, but for the present retain the name for the species here described.

Brazil : Obidos, 1♀ (V.), 1 ♂ and 1 ♀ (B.) ; Rio de Janeiro, 1 ♂ (P.) ; Uberaba 1 ♀ (V.) ; no locality, 1 ♂ (V.), 1 ♂ and 1 ♀ (B.). *Paraguay :* San Bernardino, 1 ♀ (W.). *Argentina :* Missiones, 1 ♂, 7 ♀♀ (P.) ; Chaco de Santiago del Estero, 17 ♂♂, 12 ♀♀ (P.) ; Rioja, 1 ♂ (B.) ; Salta, 2500 m., 1 ♀ (V.) ; Mendoza, 1 ♂ (P.), 2 ♂ (V.), 2 ♀ (B.) ; no locality, 2 ♂♂ and 2 ♀♀ (L.), 2 ♂♂ (W.).

Dated specimens from the Argentine suggest that the species is found from November to June. In all localities the fifth segment of the hind tarsi is black.

I have little doubt that the following species, known to me only from their descriptions, are synonyms of *T. rogenhoferi* Kohl.

T. holoneurum Schrottky (1910, p. 69), Argentina and Paraguay.
T. argentinum Brèthes (1910, p. 284), ♀, Argentina, Chacras de Coria.
,, ,, (1913, p. 154), ♂.
T. festivum Brèthes (1913, p. 156), ♂, Argentina, Missiones.
T. incognitum Brèthes (1913, p. 154), ♀, no locality.

T. bensoni sp. n.

Male. Black, mandibles, knees and sides of tergites 1–3 pitchy red ; hind tarsi white except for basal half of basitarsus and fifth segment, wings subhyaline, a little darker on the costa. All pubescence silvery. Length 13 mm.

Resembles *T. rogenhoferi*, but ocelli separated by a little less than half their diameter from eyes. Supraantennal keel nearly obsolete. Antenna with segment 13 twice as long as broad. Clypeus a little produced, not keeled, central process broader, nearly as broad as the plate beneath it. Pleural suture proceeding one-fifth of the way up the pleuron. Thorax even more finely punctured, the punctures of the mesonotum being separated by 4–5 times their diameter. Spiracular area nearly twice as long as broad.

Type. ♂, Nicaragua, F. Smith coll. (L.).

T. cinereum Cameron (1889).

(= *T. albopilosum* Fox (1891); *T. fuscipenne*, auctt. *nec* Fabricius).

Female. Black, mandibles black, hind tarsi white, basitarsus basally (one to two-thirds) black, fifth segment normally white, but sometimes brown or partly black, more rarely entirely black. Pubescence silvery. Length 17–20 mm.

Similar to *T. punctulatum* but ocelli closer to eyes, separated by one-quarter to one-half their diameter. Supraantennal keel stronger and distinctly truncate posteriorly. Clypeus unkeeled, little produced, weakly truncate with a slight central emargination. Proepisternal keel stronger, forming a distinct tooth at centre. Thorax much more finely punctured. Pleural suture hardly developed but somewhat variable. Propodeum with dorsal area less punctured, posterior surface with a subcircular depression above separated by its own length from orifice, below a deep keeled depression not defined above. Hind tibiae with a more or less distinct anterior keel. Spiracular area about twice as long as broad. Sixth tergite usually more strongly keeled.

Male similar but rather smaller, thirteenth antennal segment twice as long as broad, seventh tergite keeled, the keel projecting as hook.

Specimens seen: 29 ♂♂ and 68 ♀♀. These range from New York to Argentina, there being records from the following countries: U.S.A., Mexico, Costa Rica, Guatemala, Panama, Colombia, Ecuador, Bolivia, Peru, the Guianas, Trinidad, Brazil, Paraguay and the Argentine (Tucuman). I cannot find any trace of geographical variation in the series with one possible exception. In specimens captured south of latitude 15° S. (1 ♂, 7 ♀♀) the fifth segment of the hind tarsi is black. In the specimens from further north (25 ♂♂, 61 ♀♀) only 8 specimens (3 ♂♂, 5 ♀♀) have this segment entirely black. On the other hand, a number of them have some intermediate condition. The specimens from the U.S.A. (1 ♂, 5 ♀♀) have the segment white, except one female which has the apical half of it black. I have made a very careful examination of the United States species (= *T. albopilosum* Fox) and I cannot distinguish it from the more southern specimens. The type of *T. cinereum* Cam. (♀, Mexico, Presidio (*Forrer*) B.C.A.) is in the collection of the British Museum.

The following species may be synonyms:—

T. striatum Provancher (1888, p. 283), Canada.

T. luteitarse Saussure (1867, p. 82), Mexico.

Further, Rohwer (1909*a*, p. 380) has described a variety *planoense* of *T. albopilosum* Fox, from Texas.

T. surinamense sp. n.

Female. Black, including mandibles and fifth hind tarsal segment. Remainder of hind tarsi white except for extreme base of basitarsus. Fore-wings brown, more hyaline towards the base; hind-wings nearly hyaline. Length about 17 mm.

Exceedingly close to *T. cinereum* Cam., only differs as follows:—Supraantennal keel rather stronger. Pleural suture extends half-way up the pleuron. Mesonotum more strongly punctured than in average specimens of *T. cinereum*. Furrow of posterior surface of propodeum continuous with the keeled depression.

Type. ♀, British Guiana, Essequibo, Moraballi Creek, 21 Sept. '29, O.U.Exped. Brit. Guiana, 1929, no. 2471 (L.). Paratypes. *Mexico:* ♀, Tehuantepec, April (*W. M. Mann*) (W.). *Dutch Guiana:* ♀, Surinam (V.). *Peru:* ♀, Peras (V.). *Brazil:* ♀, Prov. Para, Obidos (*P. Kibler*) (B.).

T. pectorale sp. n.

Closely resembles small specimens of *T. cinereum* Cam. Fifth segment of hind tarsi white. Length 15 mm.

Punctures of vertex not quite so close. Ocelli separated by no more than one-quarter their diameter from eyes. Clypeus not keeled, apical margin with a small central emargination, covering one-quarter its width, partly filled in at a lower level, with indications of another minute emargination on each side of it. Proepisternal keel a little stronger, forming a small tooth at sides and a bigger one at centre. Whole thorax more finely punctured, mesonotum hardly visibly punctured. Pleural suture extending one-third of the way up the pleuron.

Type. ♀, Mexico, Guerrero, 300 ft., Sept. (*H. H. Smith*) (B.C.A.). Allotype. ♂, Mexico, C. F. Baker, no. 21511 (W.). Paratype. ♂, N. Yucatan (*Gaumer*) (B.C.A.); ♂, B.W.I., Trinidad, Oct. '33 (*D. Vesey FitzGerald*).

GROUP OF *T. NITIDUM* SM.

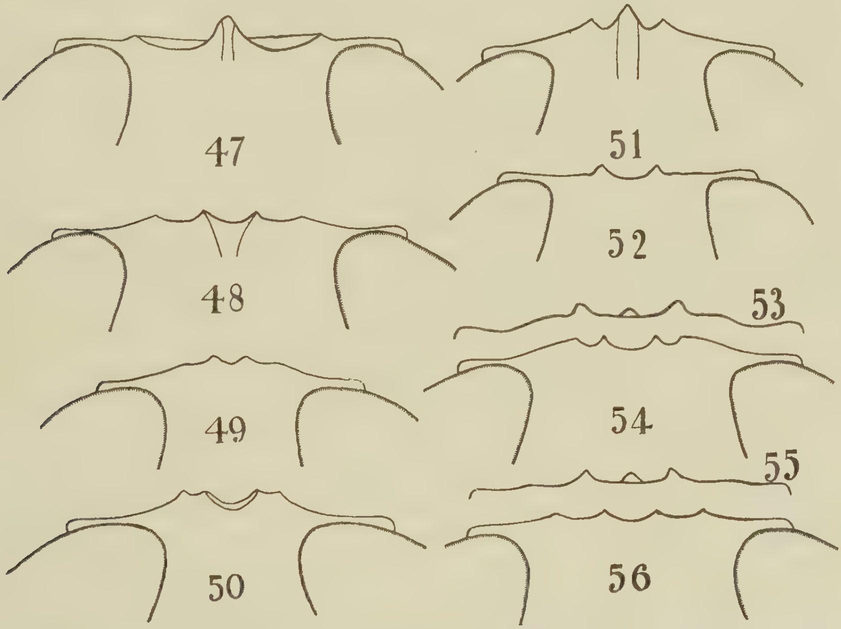
It is not easy to find many characters common to all the members of this large and structurally diverse group, which contains all the species of the subgenus *Trypargilum* which do not fall into well-defined groups.

Antennal sockets separated by from half to one times the diameter of a socket. Limiting keels of the antennal scrobes, if developed parallel. Clypeus with the apical margin of variable outline but nearly always at least emarginate, with never more than sparse outstanding hairs, height more or less distinctly greater than the least width between the eyes below. Mandibles simple. Occipital keels normally incomplete (complete in the group of *T. excavatum* Sm. and in *T. alleni* sp. n.; meeting the buccal cavity in *T. rubrocinctum* Pack. and nearly so in several species), horizontal space behind the buccal cavity distinct. Lateral tubercles of pronotum elongate, either sharp or rounded. Angles of pronotal collar often bordered. Proepisternal keel variable, usually more or less distinct, sometimes with strong teeth. Prepectus with or without dorsal and ventral longitudinal keels. Mesopleural suture developed or rudimentary. Furrow in front of the mid coxae usually strong and crossed by a few keels. Metapleural keel strongly curved, area defined or not. Lateral lobes of postnotum raised into moderately high lamellae with hyaline downcurved edges. Furrow joining depressions in the metapleural-propodeal suture usually weak and not crenate. Dorsal margin of orifice of propodeum broad usually flat but sometimes more or less sloping in towards the orifice, which is more or less distinctly broader than high. Fore coxae without bristles at the apex in the female, keels usually rather strong and converging but the ventral keel absent in a few species. Mid coxae usually with a strong outer keel, sometimes situate not quite on the extreme outer edge of coxa. Hind coxa with an inner dorsal keel on the inner edge of coxa usually proceeding to the apex or nearly. Forewings with the costa not produced beyond the radial cell, last section of M_{3+4} and im_1 usually set at an angle of about 135°, rarely at so little as 110°, last section of M_{1+2} usually one and a quarter to two and two-thirds times (rarely 3—*T. vagum* Sm., *T. vagulum* sp. n. and *T. scrobiferum* sp. n.) the penultimate. Two groups of hamuli on the hind-wings consisting of 5–8 and 3–8 hooks each, separated by from half to one and a half times the length of the apical group. Sternites 2–5 with only a few hairs around the bases of the bristles (except the female of *T. triodon* sp. n.) which are present to the number of 2–3 on each side of at least sternites 3–5. Male seventh sternite often with an apical keel projecting as a hook. Male with base of second sternite often impressed, while the apices of the second and third are often raised. Eighth sternite of the male produced at apex into two long prongs. Male genitalia with the stipes and squama completely fused, usually very long and narrow; volsellae fused for most of their length, separated by an emargination at their apex, no basal lobe; sagittae more or less long and narrow, usually recurved at their apex.

Size moderate, 10–16 mm. in length; *T. scrobiferum* sp. n., 9 mm., *T. vagulum* sp. n., 9·5 mm. Coloration variable but legs and abdomen usually more or less pale marked. The group is found throughout America where its representatives form the bulk of the moderate-sized species.

The following species, known to me only from the description, appears to belong to this group :—

T. annulatum Brèthes (1913, p. 156), Argentina, Missiones. Near *T. nitidum* Sm.



FIGS. 47–56.—(47) Antero-dorsal view of clypeus of *T. tenoctitlan* sp. n., male. (48) The same of *T. melanopteron* sp. n., male. (49) The same of *T. excavatum* Sm., female. (50) The same of *T. excavatum* Sm., male. (51) The same of *T. fugax* F., female. (52) The same of *T. optimum* sp. n., male. (53) The same of *T. mutatum* Kohl, male. (54) The same of *T. mutatum* Kohl var. *confluens* var. n., female. (55) The same of *T. transversistriatum* Strand, male. (56) The same of *T. transversistriatum* Strand, female.

SUBGROUP OF *T. EXCAVATUM* SM.

Inner dorsal keel of hind coxae strong, extending to apex where it is stronger and usually reflexed, widely separated from the emargination for the reception of the trochanter. Occipital keel complete. Pronotal collar with angles not prominent, not bordered. Pronotal tubercles long, sharp-edged. Prepectus with no dorsal keel, no ventral keel (except in *T. rohweri* sp. n.). Proepisternum with strong teeth at its sides and centre. Pleural suture not or hardly developed. Central length of clypeus one and a third times longer than least width between eyes below. Sides of dorsal area of propodeum usually raised. Black species with conspicuous silvery patches of pubescence; wings hyaline with apex and radial cell sharply dark brown. Species of Greater Antilles.

This group connects with that of *T. spinosum* Cam. through *T. projectum* Fox and *T. tridentatum* Pack.

T. excavatum Smith (1856).

Female. Black. Mandibles reddish, yellow towards base. Wings hyaline with the apex and radial cell clouded. Pubescence very dense on usual areas, forming bright silvery patches. Length 12·5 mm.

Occiput dull, closely and finely punctured, densely alutaceous. Eyes separated by the same distance at clypeus as on occiput, distance about equal to 2 + 3 of antennae. Ocelli separated by one-third of their diameter from eyes, by about diameter from one another. Vertex densely alutaceous dull, with a fine central furrow and sparse, very shallow punctures. Supraantennal keel moderately strong with a fine central keel. Limiting keels of antennal scrobes not developed. Antennal sockets separated by their diameter. Antennae with scape about twice as long as broad in middle, 3 five times as long as broad, a little shorter than 4 + 5, 4 as long as 5, three times as long as broad, 12 a little longer than 11. Clypeus (fig. 49) unkeeled with a small central emargination. Occipital keels strong, complete, horizontal space narrow. Tempora beneath with fine sparse punctures. Stipes of maxillae smooth and shining. Proepisternal keel with very strong downwardly directed teeth at sides and centre obliterated between them. Mesopleuron shining, very sparsely and shallowly punctured. Mesonotum and scutellum shining with a milky bloom, very sparsely and finely punctured. Scutellum flat. Metanotum flat, unpunctured, lateral lobes hardly striate, posterior margin narrowly raised, depressions large and shallow. Lateral lobes of metapostnotum moderately large, margin hyaline and downcurved. Metapleural keel strongly curved, area defined. Metasternum with a small V-shaped emargination. Propodeum with dorsal surface flat, disc very slightly depressed, unpunctured with faintest traces of transverse striation. Sides somewhat rugose posteriorly, shining anteriorly, very finely and sparsely punctured. Posterior surface with a deep narrow furrow, shallowing out below but approaching to near orifice, a distinct keeled depression, angles finely, regularly and sparsely striate, keels short. First abdominal tergite with no furrow, spiracular area rather longer than broad, tergite at base hardly as broad as length of hind trochanter, one and a half times as broad at apex, rather longer than hind femur + trochanter. Second tergite two-thirds as long as first, two and a half times as long as broad at apex. First tergite little, second scarcely at all contracted at apex. Sixth tergite unkeeled but with a smooth central line. Sternites bare.

Male. Similar, but ocelli separated by about one-quarter their diameter from eyes. Antennae with 13 one and a quarter times as long as 12. Clypeus (fig. 50) with centre slightly produced, the production emarginate. Propodeum with dorsal area strongly depressed on the central triangle, sides raised but rounded. Apophyses of first tergite more definitely angular. Seventh tergite with a keel projecting beyond apex as a small spine. Sternites 2 and 3 with diagonally placed rounded tubercles posteriorly, nearly meeting centrally, 4 with less obvious lateral tubercles.

Specimens seen: Type. ♀, Jamaica, Smith coll. (L.). Allotype. ♂, with the same data. Other specimens :—*Jamaica :* ♂♀, Yardley Chase, Santa Cruz Mts., St. Elizabeth, 1500 ft., Sept. Oct. '99 (*C. B. Taylor*) (W.); ♂, Rae Town, sea-level, July '97 (*C. B. Taylor*) (W.). *Haiti :* ♀, Port au

Prince, '25, no. 1020–25 (*G. N. Wolcott*) (W.). The last-named specimen has the wings rather darker and is rather smaller but is not clearly separable.

T. rohweri sp. n.

Female. Length 13 mm.

Closely similar to *T. excavatum* Sm., but differs as follows :—Occiput more shining. Eyes hardly separated by more than length of antennal segment 3. Ocelli separated by one-quarter their diameter from eyes, by three-quarters their diameter from one another. Antennal sockets separated by one-third their diameter. Antennal segment 12 little longer than 11, about twice as long as broad. Clypeus with a broad polished apex, evenly rounded. Proepisternum with tubercle sharp-edged posteriorly and sending a keel inwards to meet a strong downwardly directed, hair-bearing tooth in centre; behind the tubercle a moderately strong lateral tooth. Prepectus with a strong ventral keel. Mesonotum more closely punctured. Dorsal area of propodeum with central triangle more distinct sunk, striate throughout, sides of dorsal area striate behind, punctate in front. Posterior surface with furrow ill-defined and dying away before orifice. Angles not strongly and rather irregularly striate, keels not developed. First tergite rather narrower posteriorly (one and a quarter times as wide as at base). Sixth tergite distinctly keeled at extreme apex. Disc of second sternite very slightly swollen, third with a very slight swelling on each side posteriorly.

Male. Occiput and vertex rather duller, latter apparently more closely punctured. Antennae with 4 and 5 rather shorter, about two and two-third times as long as broad, 13 one and two-thirds times as long as 12. Propodeum with sides of dorsal area posteriorly produced into acute lamellae on each side of furrow of posterior surface, from these lamellae, striae radiate outwards and anteriorly. Furrow of posterior surface weaker. Second tergite nearly three times as long as broad at apex. Last tergite with a slight projection at apex but no keel. Central three-quarters of second sternite strongly raised on apical quarter, posterior margin of raised area straight, anterior margin curved in a horseshoe-shaped curve. Third sternite with a strongly raised rounded prominence on each side, just meeting one another at centre. Fourth sternite with traces of similar callosities.

Type. ♀, Haiti, Port au Prince, Sept. '24 (*O. Hofmann*) (W.). Allotype. ♂, Port au Prince, '25, no. 1020–25 (*G. N. Wolcott*) (W.).

T. subimpressum Sm.

Male. Very similar to *T. excavatum* Sm., but differs as follows :—Mandibles dark pitchy red. Length 10 mm.

Eyes a little closer together at clypeus than on occiput where separated by about the length of antennal segment 3. Ocelli separated by about one-third their diameter from eyes. Supraantennal keel very distinctly truncate behind. Antennal segments 4 and 5 about two and a quarter times as long as broad. Clypeus with four small apical teeth. Propodeum with disc of dorsal area not depressed, scarcely punctured. Sides obsoletely and sparsely punctured. Posterior surface with the deep furrow separated by its own length from the orifice, keeled depression large but not defined above, angles hardly striate. Apophyses of first tergite not angular. Seventh tergite with a very slight hook projecting at apex. Base of sternites 2 and 3 somewhat impressed, apex with a slight longitudinal swelling on each side.

Type. ♂, S. Domingo (L.). Other specimens : ♂, S. Domingo, S. Francesco Mts., 15 Sept. (*A. Busck*) (W.); ♂, Cuba, Havana (*P. Serre*) '14 (P.).

Differs from the other species of the group in the feebly developed callosities on the abdominal sternites and in its small size.

T. mayri sp. n.

Female. Resembles *T. excavatum* Sm., but differs as follows :—Mandibles rather darker. Length 12·5 mm.

Occiput moderately shining, unsculptured. Ocelli separated by one-quarter their diameter from eyes. Punctures of vertex closer. Truncation of supraantennal keel about as large as median ocellus. Antennal sockets separated by distinctly less than their diameter. Apex of clypeus rounded. Area beneath metapleural keel not or weakly defined. Posterior surface of propodeum with the angles regularly and rather strongly striate.

Male. Clypeus with rather less than the central third produced into a subrectangular process which bears rather strong pointed teeth at each side and a rather strong truncate one in the centre. Dorsal area of propodeum with central area depressed, its sides roundly prominent especially on each side of the top of the furrow; these prominences much less distinct than in *T. excavatum*, but much more so than in *T. subimpressum*; disc of dorsal area smooth, raised sides finely punctured, outside them finely striate. Abdominal sternite 2 with a slight transverse callosity at apex, sternite 3 with a rather more distinct one, following sternites with faint traces of callosities.

Type. ♂, Cuba (*Rühl*), coll. Mayr (V.). Allotypes. Two ♀♀ on one pin, Cuba (*Rühl*) (B.).

T. cubense sp. n.

Male. Very similar to *T. excavatum* Sm., but differs as follows :—Length 11 mm.

Occiput smooth and shining. Eyes hardly separated by more than length of third antennal segment. Ocelli practically contiguous to eyes. Vertex more closely punctured. Supraantennal keel not at all raised, truncation very small. Antennal sockets separated by half their diameter. Segments 4 and 5 of antennae about two and a half times as long as broad. Apex of clypeus with rather more than the central third produced into a subrectangular lobe of which the margin is weakly trisinuate. Area beneath metapleural keel feebly defined. Propodeum with dorsal area deeply sunk over a central triangle, especially posteriorly, the sunk area smooth and shining; on each side of it at top of furrow a strong flattened spike (nearly high as length of metanotum), from each of which proceeds a fine keel which defines the dorsal area laterally. Sides finely but closely punctured, shining. Furrow of posterior surface ends at half its length from orifice, a strong keeled depression, well defined above; furrow also crossed by a few weak keels. Angles shining, below densely hairy, with fine irregular keels. Second abdominal tergite only one and three-quarters times as long as broad at apex. Second abdominal sternite with a rather strong transverse apical callosity occupying central half. Third sternite with a curved subapical callosity covering three-quarters of its width, base of sternite rather depressed.

Type. ♂, Cuba (*Rühl*) (B.).

SUBGROUP OF *T. AUREOVESTITUM* TASCHBG.

Limiting keels of antennal scrobes (fig. 4) long, approximated, first parallel then diverging. Prepectus with ventral keel, with or without dorsal one. Pronotal collar not bordered. Pronotal tubercles rather strong. Proepisternal keel distinct but without teeth. Pleural suture well-developed. Clypeus one and a third times longer than least width between eyes below. Apex of clypeus rounded or truncate. Inner dorsal keel of hind coxae strong to near apex but not widely separated from emargination for reception of trochanters. First and second tergites strongly contracted posteriorly.

S. America.

T. aureovestitum Taschenberg (1875).

Female. Black, first six segments of antennae, apex of clypeus, mandibles, palps, pronotal tubercles and tegulae, fore tibiae and tarsi, apex of fore femora, very narrow apex of mid femora, basal half of mid tibiae, mid basitarsus and annulations of other mid tarsal segments, junction of hind tibiae and femora, annulations of hind tarsi, sides and a very narrow apical band to first abdominal segment, narrow basal band, sides and basal part of sternite on second segment, reddish-testaceous. Wings hyaline, a little darker in radial cell and along costa beyond it. Pubescence light brassy, short but dense, hiding surface of dorsal surface, posterior surface and angles of propodeum. Abdomen with dense, short brassy tomentum. Length 10 mm.

Occiput shining, closely and finely punctured. Eyes a little closer together at clypeus than at occiput where they are separated by about the length of antennal segments 2 + 3. Ocelli separated by half their diameter from eyes, by two-thirds of their diameter from one another. Vertex dull, closely and subconfluently but very finely punctured. Supra-antennal keel consisting of a weak central keel from which diverge posteriorly two others, parallel to one another and twice as long as it. Limiting keels of antennal scrobes strong, at first a little diverging, then parallel, longer than scape + 2 of antennae, enclosing an area which is twice as long as broad in the centre. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as its greatest width, 3 four times as long as broad, shorter than 4 + 5, 4 a little longer than 5 which is two and a third times as long as broad, remaining segments all longer than broad, 12 a little longer than 11. Clypeus with apex rather broadly polished, preceded by a faint central keel. Occipital keels not quite complete, horizontal space behind the buccal cavity very narrow. Tempora beneath shining, finely and sparsely punctured. Stipes of maxillae, shining, punctured. Mesopleuron finely and not very closely punctured, prepectus with dorsal keel nearly complete. Mesonotum and scutellum shining, finely and not very closely punctured, scutellum flat. Metanotum entirely hidden by dense pubescence. Lateral lobes of the metapostnotum unusually large. Metapleural keel strongly curved, area defined. Metasternum with a broad V-shaped emargination. Propodeum with dorsal surface somewhat depressed centrally, defined by round, finely punctured prominences, discal surface cross-striate, nearly hidden by hairs. Posterior surface with a shallow, ill-defined furrow ending below in a well-defined keeled depression, angles without keels, hidden by pubescence. Sides closely striate, dull. Hind tibiae rounded. First abdominal tergite with a short furrow, apophyses weak, spiracular area one and a half times as long as broad. First tergite at base a little broader than length of hind trochanter, twice as broad at apex, about as long as hind femur + trochanter, second tergite about half as long as first, one and a third times as long as broad at apex, first two tergites strongly contracted at apex. Sixth tergite unkeeled. Sternites shining.

Male. Antennae with third segment only three and a half times as long as broad, as long as 4 + 5, 5 twice as long as broad, 13 a little longer than 12. Clypeus with four distinct teeth at apex. Mesopectus even more obsoletely punctured. Seventh tergite with a short keel projecting as a hook at apex. Second sternite somewhat depressed at its base.

Specimens seen: Type. ♀, Mendoza, Argentina (H.). Other specimens: 19 ♂♂, 7 ♀♀, Argentina, Santiago del Estero (*E. R. Wagner*), various localities (P.). *T. tucumanum* Brèthes (1913, p. 153), Tucuman, is probably a synonym.

T. scrobiferum sp. n.

Female. Black, antennae somewhat pitchy, apex of segments 1–2 reddish, mandibles, palps, apex fore femora, fore tibiae and tarsi, narrow apex to mid femora, mid tibiae and tarsi (segments 2 and 3 of latter somewhat darkened), base of hind tarsal segments 1–3, whole of 4 and 5, sides of abdominal segments 1–3, reddish. Wings hyaline. Pubescence silvery, not very dense. Length 9 mm.

Structurally very similar to *T. aureovestitum* Taschbg., but differs as follows:—Ocelli separated by no more than one-quarter their diameter from eyes. Supraantennal keel weaker. Limiting keels of antennal scrobes longer and more sharply angled. Antennal sockets separated by rather less than their diameter. Clypeus with apical margin rounded. Proepisternum with a much stronger keel. Prepectus without a dorsal keel. Mesonotum more closely punctured. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface somewhat depressed on disc, not very pubescent, surface with fine cross-striae which are diagonal at base and transverse at apex. Posterior surface with a moderately deep and well-defined furrow, ending at its own length from orifice in a transverse keel, followed shortly by another which is half-way between it and the broad keeled depression, angles rather strongly striate. Sides well defined above, smooth and shining. First abdominal tergite with almost no furrow, spiracular area two and a half times as long as broad. First tergite at base rather narrower than length of hind trochanter, rather more than twice as broad at apex. Second tergite two-thirds as long as first, nearly twice as long as broad at apex.

Type. ♀, British Guiana, Essequibo River, Moraballi Creek, 22 Sept. '29, on stump of "Mora bukir," no. 2584, O.U.Exped. Brit. Guiana (L.).

SUBGROUP OF *T. FUGAX* F.

Prepectus with strong ventral keel, dorsal keel usually weak or absent. Pronotal collar usually more or less bordered. Proepisternal keel strong and sharp-edged usually produced into one or two teeth. Pleural suture usually little developed. Apex of clypeus nearly always with three or four teeth. Inner dorsal keel of hind coxae extending to apex but here approximated to emargination for reception of trochanters.

C. and S. America.

T. fugax Fabricius (1804).

Female. Black, sides and very narrow apex of first abdominal tergite, apical half of first sternite, sides and base of second tergite, basal half of second sternite, and narrow bases to all tibiae, reddish. Wings hyaline, apex fuscous. Pubescence mainly brassy. Length 12·5 mm.

Occiput shining, sparsely punctured, not impressed. Eyes equally separated at clypeus and occiput, on the latter by a distance equal to length of segment 3 of antennae. Ocelli separated by rather less than half their diameter from eyes, by their diameter from one another. Vertex dull, coarsely and subconfluently punctured. Supraantennal keel fine, nearly as long as scape, narrowly truncate posteriorly. Limiting keels of antennal scrobes not very strong, enclosing a quadrate area. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as its greatest width, 3 five times as long as broad, a little shorter than 4 + 5, 4 hardly longer than 5 which is two and a half times as long as broad, remaining segments all distinctly longer than broad, 12 one and a half times as long as 11. Clypeus (fig. 51) with a polished apex and short central keel, apical margin with three teeth of which the central one is the largest. Occipital keel incomplete, horizontal space behind the buccal cavity moderately broad. Tempora beneath rather strongly and closely punctured, also finely alutaceous. Stipes of maxillae obsoletely punctured. Proepisternal keel produced into a tooth both at sides and at centre. Lateral tubercle of pronotum moderately strong, not very sharp-edged. Pronotal collar not bordered. Mesopleuron rather finely and sparsely punctured, prepectus with dorsal keel nearly complete. Mesonotum and scutellum moderately strongly and densely punctured. Scutellum flat. Metanotum punctured, lateral lobes striate, posterior margin hardly raised. Area beneath metapleural keel defined. Metasternum with a small V-shaped emargination. Propodeum with dorsal surface flat, sparsely and very finely punctured with indications of striae. Posterior surface with a short furrow separated from orifice by its own length, no clearly defined keeled depression, angles without keels, with regular transverse striae. Sides rather closely and finely punctured. First abdominal tergite with no furrow, spiracular area twice as long as broad, apophyses rounded, tergite at base about as broad as length of hind trochanter, at apex rather more than twice as broad, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as broad at apex as long. First tergite distinctly, second very little contracted at apex. Sixth tergite keeled. Sternites bare.

Male similar, but central tooth of clypeus rather larger, lateral ones rather smaller. Antennae with segments relatively shorter, 13 shorter than 11 + 12. Seventh tergite keeled, keel projecting at apex as a small hook.

I have not examined the type (♀) of this species, but Dr. O. Schröder kindly compared a specimen I sent him with the type in the Kiel Museum and informed me that my identification was correct.

Specimens examined: *Colombia:* ♂, Sevilla, Magd., 6 Nov. '26 (*Salt*); Rio Frio, Magd., ♀ 1 Jan., ♂ 17 Mar., ♂ 26 July, 2 ♀♀ 20 Oct. '27 (*Salt*). *British Guiana:* ♀ (*Rodway*) (L.); ♂ (L.); ♀ (*Schomburgk*) (B.); ♂, Kalacoon, 1916, no. 316 (*E. G. Howes*) (W.). *French Guiana:* ♀, Cayenne (B.). *Brazil:* ♂, Tapayos (L.); ♂, Para (L.). No locality: ♂♀ (L.). The specimen from Kalacoon was identified by Rohwer as *T. columbianum* Sauss. This synonymy is probably correct, but I have not seen the type. *T. medianum* Fox (1897, p. 385), Santarem, is probably another synonym.

var. **santa martae** var. n.

Male. Pubescence silvery. Clypeus with strong tooth very small, smaller than the lateral ones.

Type. ♂, Colombia, Cartagena, 30 Nov. '26 (*Salt*). Paratype. ♂, Colombia, Santa Marta, 17 July '27 (*Salt*). Some of Dr. Salt's Colombian specimens of *T. fugax* intergrade with the variety.

T. transversistriatum Strand (1910).

Female. Black, tegulae, base of tibiae narrowly, sides of first abdominal tergite, base and sides of second, testaceous tinged. Wings nearly hyaline. Pubescence brassy except on clypeus and mesopleuron where silvery. Length 12 mm.

Occiput flat, shining, finely punctured. Eyes distinctly closer together at clypeus than on occiput where separated by a distance equal to the length of antennal segments 2 + 3. Ocelli separated by about half their diameter from eyes, by their diameter from one another. Vertex dull, more shining near ocelli, coarsely, closely and shallowly punctured, central furrow shallow. Supraantennal keel very little developed. Limiting keels of antennal scrobes as long as antennal scape. Antennal sockets separated by about their diameter. Antennae with scape nearly twice as long as its greatest width, 3 four times as long as broad, shorter than 4 + 5, 4 about equal to 5, nearly twice as long as broad, remaining segments all distinctly longer than broad, 12 hardly longer than 11, one and two-thirds times as long as broad. Clypeus (fig. 56) with a central emargination and a weaker one on each side. Occipital keel incomplete, horizontal space behind the buccal cavity moderately broad. Tempora beneath shining, moderately strongly but sparsely punctured. Stipes of maxillae smooth and shining. Proepisternal keel with a strong tooth at sides and centre, but obliterated between them. Lateral tubercle of pronotum moderately strong and sharp-edged. Pronotal collar with angles distinctly bordered. Mesopleuron shining, rather strongly and sparsely punctured, prepectus with keel half crossing it. Mesonotum coarsely and rather closely punctured, scutellum more finely, flat. Metanotum nearly flat, finely punctured, lateral lobes striate and hairy, posterior margin not raised and hyaline, depressions shallow. Area beneath metapleural keel defined. Metasternum with a small V-shaped emargination. Propodeum with dorsal area not very strongly punctured and obsoletely striate, dull, disc more shining, more finely punctured. Posterior surface with a deep narrow furrow (distincter than in *T. fugax* F.), keeled depression poorly defined, angles without keels, rather coarsely rugose. Sides dull rather finely and closely punctured and obsoletely striate. First abdominal tergite with a short furrow, spiracular area a little longer than quadrate, apophyses rather strong, tergite at base as broad as length of hind trochanter, twice as broad at apex, nearly as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and two-thirds times as long as broad at apex. First tergite moderately, second hardly contracted at apex. Sixth tergite not keeled. Sternites bare.

Male. Ocelli separated by one-third their diameter or rather more from eyes. Antennal segment 13 about twice as long as broad, distinctly shorter than 11 + 12. Clypeus tridentate, central tooth (fig. 55) often reduced, the two outer ones often forming a trapezoidal projecting plate. Seventh abdominal tergite with an apical keel projecting as a hook.

This species is somewhat variable in structure. Particularly in the strength of the central tooth of the clypeus, the length of keel crossing the prepectus dorsally, the strength of the punctures of the mesonotum and the striae of the propodeum. In some specimens the mesonotum is hardly more strongly punctured than in *T. fugax* F., but normally these species are quite distinct in this respect.

Specimens seen: Type. ♂, Villa Morra, Paraguay, 20 Dec. '05 (*J. D. Anisits*) (B.). Paratype. ♀, Asuncion, Paraguay, 31 Dec. '05 (*J. D. Anisits*) (B.). Other specimens:—3 ♂♂, 2 ♀♀, Paraguay, San Bernardino (*Fiebrig*) (V.); 1 ♂, same data (W.). Argentina: 2 ♂♂, 3 ♀♀, near Icano, Chaco de Santiago del Estero (P.).

This species is very close to *T. mutatum* Kohl and almost intergrades with it. They may be separated as follows:—

T. transversistriatum. Dorsal area of propodeum moderately shining, with the transverse striae more obvious than the punctures. Base of second abdominal tergite usually dark.

T. mutatum. Dorsal area of propodeum quite dull, striae scarcely developed, finely and densely punctured. Second abdominal tergite usually basally distinctly red. Mesonotal punctures on the whole stronger. Smooth spaces between punctures of vertex more numerous and larger.

T. mutatum Kohl (1884).

(= *T. coloratum* Taschenberg (1875) *nec* Smith).

Female. Black, mandibles, tegulae, sides, very narrow apex and sternite of first abdominal segment, basal half dorsally, sides and sternite of second segment, reddish. Wings subhyaline. Pubescence silvery, moderately dense on the usual areas. Length 12·5 mm.

Occiput shining, rather closely punctured. Eyes distinctly closer on clypeus than on occiput, where they are separated by distance equal to length of segments 2 + 3 of the antennae. Ocelli separated by hardly more than half their diameter from eyes, by their diameter from each other. Vertex coarsely and almost confluently punctured, shining between the punctures, with small, irregular shining areas in the neighbourhood of the ocelli. Supraantennal keel little raised, truncate posteriorly. Limiting keels of antennal scrobes moderately strong, as long as the antennal scape, enclosing a quadrate area. Antennal sockets separated by their diameter. Antennae with scape twice as long as broad in middle, 3 four times as long as broad, nearly as long as 4 + 5, 4 and 5 subequal two and a half times as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad. Clypeus unkeeled, with a small central emargination and another smaller one on each side of it. Occipital keel incomplete, horizontal space moderately broad. Tempora beneath sparsely and moderately strongly punctured, shining. Stipes of maxillae smooth and shining. Proepisternal keel very strong with a strong tooth at sides and a weaker one at centre. Lateral tubercle of pronotum moderately strong sharp-edged. Angles of pronotal collar bordered. Mesopleuron strongly but not very closely punctured, prepectus with dorsal keel extending half-way across. Mesonotum coarsely and moderately closely punctured, scutellum less so, flat. Metanotum flat, lateral lobes striate, posterior margin not raised, preceded by a rather shallow depression. Area beneath metapleural keel not strongly defined. Metasternum with a small, narrow, V-shaped slit. Propodeum with the dorsal area somewhat depressed over a central triangle, defined by the direction of the pubescence, dull and rugose with fine transverse striae on the posterior quarter. Posterior surface with a furrow which is deep above but shallow on lower half, crossed below by four fine keels in addition to the deep keeled depression, angles with short keels, dull, coarsely and confluently punctured. Sides dull, rather coarsely punctate-striate. First abdominal tergite with a furrow extending to the spiracles, spiracular area nearly twice as long as broad, apophyses strong but rounded, tergite at base about as broad as length of hind trochanter, twice as broad at apex, as long as hind femur + trochanter. Second tergite rather more than half as long as first, nearly twice as long as broad at apex. First tergite strongly, second little contracted at apex. Sixth tergite not keeled. Sternites bare.

Male. Antennae with segment 13 one and a half times as long as broad, a little longer than 12. Clypeus (fig. 53) with three small teeth at apex (central one often very weak) situated on a projecting lobe. Proepisternal teeth weaker. Mesopleuron rather less strongly punctured. Seventh tergite with a keel projecting beyond the apex as a hook.

Specimens seen : Type of *T. coloratum* Taschenberg, ♂, *Argentina*, Mendoza (H.). Further specimens :—*Argentina :* ♂, Buenos Aires (*Hensel*) (B.); 3 ♀♀ (W.); ♀, Sta. Rosa, Mendoza, 20 Jan. '95 (V.); ♀, Grand Chaco, coll. de Gaulle (P.); ♂, Chaco de Santa Fe, Las Gorzas, 25 k. W. of Ocampo (*E. R. Wagner*) (P.); 5 ♂♂, 4 ♀♀, Chaco de Santiago del Estero, various localities (*E. R. Wagner*) (P.). *Paraguay :* 3 ♂♂, San Bernardino (*Fiebrig*) (V.).

T. mutatum Kohl var. **confluens** var. n.

Female. Pubescence denser, brassy. Length 13·5 mm.

Clypeus (fig. 54) at apex with four small teeth, the outer ones smaller, the inner ones more widely separated. Proepisternal teeth weaker. Mesonotum coarsely and confluently punctured, on disc interstices are irregularly broader and shining. Propodeum with dorsal area diagonally striate at base.

Type. ♀, Uruguay, Montevideo (*Sello*) (B.).

T. optimum sp. n.

Female. Black, apex of mandibles, tegulae, sides of first abdominal tergite, base and sides of second, obscurely pale. Wings hyaline, apex darker. Pubescence silvery, not very dense. Length 12 mm.

Occiput sparsely punctured, shining, centrally depressed. Eyes hardly closer at clypeus than at occiput, where separated by a distance rather greater than length of antennal segments 2 + 3. Ocelli separated by about one-third their diameter from eyes, from one another by about their diameter. Vertex dull, subconfluently and coarsely punctured, interstices alutaceous, central furrow weak. Supraantennal keel in the form of a strong longitudinal prominence bearing a distinct dorsal keel and ending in a strong truncation. Limiting keels of antennal scrobes short but very strong, enclosing an area about one and a half times as broad as long. Antennal sockets separated by their diameter. Antennae with the scape one and a half times longer than broad in middle, apex ventrally with a slight angular projection, 3 three and a half times as long as broad, shorter than 4 + 5, 4 hardly longer than 5, 5 about twice as long as broad, 6–11 progressively a little shorter, each a little longer than broad, 12 nearly twice as long as broad, one and a half times longer than broad. Clypeus unkeeled, apical third smooth and shining, a little upturned, margin with two fairly strong obtuse teeth, outside each of which is a small emargination. Occipital keels strong, nearly reaching buccal cavity, horizontal space narrow. Tempora beneath shining, sparsely and moderately strongly punctured. Stipes of maxillae shining, sparsely punctured. Proepisternal keel weak, forming a small tooth at sides. Lateral tubercle of pronotum not strong, sharp-edged, angles of pronotal collar hardly bordered. Mesopleuron shining, sparsely but quite strongly punctured, prepectus with dorsal keel extending halfway across. Mesonotum shining, rather sparsely but moderately strongly punctured. Scutellum flat, more finely punctured. Metanotum flat, finely punctured, lateral lobes striate, posterior margin very narrowly raised and membranous, preceded by a shallow hair-filled depression. Area beneath metapleural keel defined. Metasternum with a broad V-shaped emargination. Propodeum with dorsal area a little depressed with fine striae which are diagonal at base and transverse posteriorly. Posterior surface with a deep narrow furrow to near the orifice, with a strong keeled depression and another keel crossing the furrow just above this. Angles without keels, rather coarsely and irregularly striate. Sides moderately shining, finely punctate striate. First abdominal tergite with a slight furrow, spiracular area a little longer than broad, apophyses rounded, tergite at base as broad as length of hind trochanter, one and three-quarters times as broad at apex, as long as the hind femur + trochanter. Second tergite two-thirds as long as the first, one and three-quarters times as long as broad at the apex. First tergite rather strongly, second moderately contracted at the apex. Sixth tergite with a keel on the apical third. Sternites bare.

Male. Pale colour rather more extensive. Length 10 mm.

Ocelli separated by about half their diameter from eyes. Apex of clypeus (fig. 52) with a rather deep emargination defined by small teeth. Antennae with 13 one and a half times as long as 12. Seventh tergite with the extreme apex keeled, the keel projecting as a small hook.

Type. ♂, Brazil, F. Smith coll. (L.). Allotype. ♀, Argentina, Mendoza, 12 Nov. '06 (*Jensen-Haarup*) (B.). Paratype ♂, same locality, 22 Dec. '06.

T. optimum sp. n. **regium** var. n.

Female. Similar, but vertex more coarsely rugose, central furrow stronger. Limiting keels of antennal scrobes stronger, ending posteriorly in a small transverse plate. Antennal sockets separated by two-thirds their diameter. Mesonotum more strongly and closely punctured. Propodeum with the two keels crossing the furrow of posterior surface even stronger, angles more strongly striate, with distinct keels enclosing an area about as long as broad. Length 12 mm.

Type. ♀, Brazil, St. João del Rey (*Sello*) (B.).

T. alleni sp. n.

Male. Black, base of mandibles, tegulae in part, first two abdominal tergites (except an apical spot), base of third, sternites 1–2 and the basal half of 3, red. Wings subhyaline. Pubescence silvery. Length 10 mm.

Occiput transversely raised behind the ocelli, centrally a little depressed, shining with irregular depressions. Eyes distinctly closer at clypeus than at occiput, where they are separated by a distance equal to length of segments 2 + 3 of antennae. Ocelli lying in slight depressions, separated by not more than one-quarter their diameter from eyes, by nearly their diameter from one another. Vertex very coarsely but not very closely punctured, interstices shining, central furrow weak. Supraantennal keel very weak. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by half their diameter. Antennae with scape one and a half times as long as greatest width, 3 four and a half times as long as broad, not so long as 4 + 5, 4 as long as 5, about two and a half times as long as broad, remaining segments all a little longer than broad, 13 one and a half times as long as 12. Clypeus with a rather large apical, trapezoidal projection, covering half its apical width, apex of projection emarginate. Occipital keels practically complete, horizontal space narrow. Tempora beneath shining, finely and sparsely punctured. Proepisternal keel strong, forming a large rounded lobe at sides, and a strong tooth at centre. Lateral tubercle of pronotum moderately strong, sharp-edged; pronotal collar obtusely bordered on lower half. Pleural suture well developed. Mesopleuron rather coarsely but very sparsely punctured (punctures somewhat irregular but mostly separated by 5–6 times their diameter), prepectus with no dorsal keel. Mesonotum and scutellum shining, former coarsely and rather closely (one and a half diameters) punctured, latter flat, more sparsely punctured. Metanotum flat, finely punctured, lateral lobes hairy, striate, no membranous margin, depressions small. Area beneath metapleural keel defined. Metasternum invisible. Propodeum with dorsal surface somewhat depressed posteriorly, surface with striae which are diagonal at base and transverse at apex, where they are weaker. Posterior surface with a narrow furrow extending to the orifice, keeled depression not defined, angles striate, without keels. Sides finely and closely punctured. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses very weak, first tergite nearly as wide at base as length of hind trochanter, one and a half times as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, twice as long as broad at apex. First tergite moderately, second very little contracted at apex. Seventh tergite with a short keel projecting beyond the apex as a small hook. Sternites bare.

Type. ♂, Colombia, Lake Sapatoza Region, Chiriguana district, March to Sept. '24 (*C. Allen*) (L.).

T. triodon sp. n.

Female. Black, mandibles, tegulae, base of tibiae narrowly, sides of first two abdominal tergites, pitchy to testaceous. Wings subhyaline, apex strongly fuscous. Pubescence very pale brassy, on mesopleuron silvery. Length 14 mm.

Occiput shining, finely alutaceous with sparse punctures. Eyes hardly closer together at clypeus than on occiput where separated by the length of antennal segments 2 + 3. Ocelli separated by rather more than half their diameter from eyes, by two-thirds their diameter from each other. Vertex dull, confluently and rugosely punctured, no central furrow. Supraantennal keel little raised, fine, not truncate behind. Limiting keels of antennal scrobes not strong, enclosing an area which is about quadrate. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times as long as broad, about as long as 4 + 5, 4 a little longer than 5 which is nearly two and a half times as long as broad, remaining segments a little longer than broad, 12 about twice as long as broad, rather longer than 11. Clypeus with a short central keel and three weak apical teeth. Occipital keel nearly meeting keel of buccal cavity, horizontal space behind buccal cavity very narrow. Tempora beneath shining, moderately closely and finely punctured, stipes of maxillae smooth and shining. Proepisternal keel strong, produced into a rounded lobe at sides and into a strong tooth at centre. Lateral tubercle of pronotum strong and sharp-edged; pronotal collar weakly bordered in lower half. Mesopleuron finely and not very closely punctured, prepectus with at most traces of dorsal keel. Mesonotum rather finely and closely punctured, more sparsely on disc. Scutellum similar, flat. Metanotum flat, finely punctured, lateral lobes striate and hairy, posterior margin not raised, depressions large and shallow. Area beneath metapleural keel defined. Metasternum with a V-shaped emargination. Propodeum with dorsal area not very shining, narrow basal area finely punctured, rest transversely striate, defined laterally by narrow punctured areas. Posterior surface with a deep furrow ending rather abruptly below at about its own length from orifice, beneath it a flat area followed by a moderately distinct keeled depression, angles with very short keels, closely and finely striate. Sides moderately shining, finely striate with some punctures anteriorly. First abdominal tergite with no furrow, spiracular area nearly twice as long as broad, apophyses very weak, tergite at base as broad as length of hind trochanter, a little more than twice as broad at apex, as long as femur + trochanter + half the length of coxa. Second tergite half the length of first, one and a half times as long as broad at apex. First tergite rather strongly, second moderately contracted at apex. Sixth tergite rather strongly keeled. Sternites 2–5 dull, punctured and hairy.

Male. Length about 11 mm. Ocelli separated by about one-third their diameter from eyes. Antennae with 13 about twice as long as broad. Clypeus with two strong teeth and a small one between them, not keeled. Mesonotum rather less strongly punctured. Seventh tergite with a keel projecting as a slight hook. Sternites 3–4 with scattered pubescence, 5 densely hairy.

Type. ♂, Argentina (W.). Allotype. ♀, Argentina, Prov. Santiago del Estero, Barrancas (*E. R. Wagner*), 1909 (P.). Paratypes. 1 ♂, Argentina (W.); 2 ♂♂, Chaco de Santiago del Estero (P.).

The species differs from *T. transversistriatum* in having dorsal furrow of prepectus weaker, mesonotum less strongly punctured and sides of propodeum more strongly striate.

T. tenoctitlan sp. n.

(= *T. aztecum* Cameron (1889) *nec* Saussure).

Female. Black, mandibles pitchy, tegulae, narrow base and apex to tibiae, streak on posterior surface of hind tibiae, sides of first abdominal tergite, base of second tergite and sternite, red yellow. Wings hyaline, darker at apex and along costa. Pubescence silvery, more brassy on the propodeum. Length 13 mm.

Occiput shining, sparsely punctured, weakly impressed. Eyes rather less close on occiput than at clypeus, on the former separated by a distance equal to length of segments 2 + 3 of antennae. Ocelli separated by two-thirds their diameter from eyes, by their diameter from one another. Vertex dull, confluently rugose, central furrow obsolete. Supraantennal keel hardly developed. Limiting keels of antennal scrobes parallel to one another, enclosing an area which is about quadrate. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as broad in the middle, 3 five times as long as broad, nearly as long as 4 + 5, 4 hardly longer than 5 which is two and a half times as long as broad, remaining segments all somewhat longer than broad, 12 somewhat longer than 11. Clypeus before apex with a large central outstanding tooth, at each side of it at apex two smaller teeth, margin beneath central tooth excised and thickened. Occipital keel incomplete, horizontal space broad. Tempora beneath strongly and very closely punctured. Stipes of maxillae shining, sparsely punctured. Proepisternal keel strong, forming a rounded lobe at sides and a small tooth in centre. Lateral tubercle of pronotum strong and sharp-edged; pronotal collar not bordered. Mesopleuron moderately strongly and densely punctured, prepectus with dorsal keel of variable length (crossing 1 to ½ width of prepectus). Mesonotum densely and rather strongly punctured, scutellum more finely, flat. Metanotum flat, finely punctured, lateral lobes striate and hairy, posterior margin not hyaline, depressions large and shallow. Area beneath metapleural keel defined. Metasternum with a moderately broad V-shaped emargination. Propodeum with dorsal surface flat, unpunctured, almost not striate. Posterior surface with furrow short, separated from orifice by nearly its own length, no keeled depression, angles with keels very short, surface striate. Sides closely and moderately finely punctured. First abdominal tergite with no furrow, spiracular area nearly twice as long as broad, apophyses rounded, tergite about as broad at base as length of hind trochanter, twice as broad at apex, about as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a third times as long as width at apex. First moderately, second little contracted at apex. Sixth tergite with a strong keel. Sternites bare.

Male. Ocelli sometimes rather closer to eyes. Clypeus (fig. 47) usually with only one tooth on each side of central process which is larger (rarely traces of second tooth); thickened area beneath central tooth much more deeply emarginate. Mandibles rather strongly bent. Seventh tergite with a fine keel which does not project at apex.

Type. ♀, Mexico, Presidio (*Forrer*) (B.C.A.). Allotype. ♂, N. Yucatan (*Gaumer*) (B.C.A.). Paratypes. 1 ♀ same data as type; 2 ♀♀, 1 ♂, N. Yucatan (*Gaumer*) (B.C.A.); 1 ♀, 1 ♂, Rincon, Guerrero, Mexico, 2800 ft. Sept. (*H. H. Smith*) (B.C.A.); ♀ Guatemala, El Rancho, 900 ft., 17 Feb. '32 (*C. N. Ainslie*) (W.).

T. agamemnon sp. n.

Male. Black, mandibles pitchy, paler at base, tegulae testaceous, antennae with segments 2–5 above and all segments beneath testaceous, base and anterior side of fore tibiae, sides of first abdominal tergite, base of second both dorsally and ventrally, reddish. Wings light brown, costa to end of radial cell rather sharply darker. Pubescence silvery-brassy. Length 10 mm.

Occiput shining, finely punctured, raised into a distinct prominence on each side. Eyes hardly closer below than above where separated by a distance nearly equal to the combined lengths of antennal segments 2 + 3. Ocelli almost touching eyes, separated from one another by two-thirds their diameter. Vertex dull, finely but closely punctured. Supraantennal keel moderately raised, posterior truncation elongate, continuous with the central furrow of vertex. Limiting keels of antennal scrobes almost obsolete. Antennal sockets separated by two-thirds their diameter. Antennae with the scape one and a half times as long as broad in middle, 3 four and a half times as long as broad, as long as 4 + 5, 4 as long as 5, a little more than twice as long as broad, remaining segments all at least a little longer than broad, 13 twice as long as broad. Clypeus at apex with a rather deep central emargination, defined by small teeth, and with a smaller tooth on each side. Occipital keel incomplete, horizontal space quite broad. Tempora beneath shining, finely and sparsely punctured. Proepisternal keel rather weak, not forming teeth. Lateral tubercle of pronotum rather strong, sharp-edged, pronotal collar not bordered. Pleural suture more or less developed, extending from one-third to one-half the way along the pleuron. Mesopleuron shining, very finely and sparsely punctured, prepectus half crossed by the dorsal keel, ventral keel rather short. Mesonotum and scutellum shining, finely and moderately closely punctured, the latter flat. Metanotum finely punctured, lateral lobes hairy with a fine membranous posterior margin, preceded by moderately large depressions. Area beneath metapleural keel weakly defined. Emargination of metasternum a narrow V. Propodeum with dorsal surface flat, shining, with very faint traces of punctures and striae. Posterior surface with the furrow shallow, ending at a point half its length from orifice, keeled depression distinct, angles with no keels, shining with very weak striae. Sides moderately shining, with dense but very fine punctures. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses obsolete, tergite about as broad at base as length of hind trochanter, one and two-thirds times as broad at apex, as long as hind femur + trochanter. Second tergite hardly longer than half the first, one and a third times as long as broad at apex. First tergite rather strongly, second little contracted at apex. Seventh tergite with a dorsal keel projecting beyond its apex as a hook. Sternites bare.

Type. ♂, Tabernilla, Panama, 9 May '11 (*A. Busck*) (W.). Paratypes. ♂, Panama, Tabernilla, 23 July '07 (*A. Busck*) (W.); ♂, Panama, Trinidad River, 2 June '12 (*A. Busck*) (W.). The type had been identified by Rohwer as *T. aztecum* Sauss., but I believe that that species will be found to be a form of *T. nitidum* Sm.

T. xanthandrum sp. n.

Male. Black, mandibles, tegulae, first five and last segment of antennae, apex of propodeum beneath, legs, first abdominal segment, basal two-thirds of second, sides and apex of remaining tergites and all sternites indeterminately, yellowish-testaceous. Wings fusco-hyaline, darker towards apex. Pubescence very light brassy, almost silvery. Length 12 mm.

Occiput shining, obsoletely punctured. Eyes very large, closely approximated, at clypeus separated by twice width of second antennal segment, on occiput by less than scape + 2 of antennae. Ocelli contiguous to eyes, separated from one another by one-third their diameter. Vertex just dull, very finely alutaceous, with very large, shallow, flat-bottomed punctures, separated from one another by about their diameter, central furrow distinct. Supraantennal keel moderately strong, posterior truncation elongate enclosing an area more than twice as long as broad. Limiting keels of antennal scrobes fine but distinct about as long as scape. Antennal sockets separated by hardly more than one-third their diameter. Antennae with scape nearly twice as long as greatest width, 3 nearly six times as long as broad, slightly longer than 4 + 5, 4 as long as 5, two and a half times longer than broad, remaining segments progressively shorter, 9–12 quadrate, 13 as long as 11 + 12, twice as long as broad. Clypeus a little produced, centre weakly trisinuate. Occipital keel incomplete, horizontal space behind buccal cavity distinct. Tempora beneath shining, finely and closely punctured. Stipes of maxillae very finely and moderately closely punctured. Proepisternal keel strong and sharp-edged but without teeth except a rudimentary one at sides. Lateral tubercle of pronotum strong, sharp-edged; pronotal collar not bordered. Mesopleuron shining, sparsely and finely punctured, prepectus with no dorsal keel. Pleural suture well developed. Mesonotum shining, sparsely and obsoletely punctured, scutellum flat. Metanotum flat, hardly punctured, lateral lobes striate and hairy, posterior margin not raised and hyaline, preceded by large shallow depressions. Area beneath metapleural keel defined. Metasternum with a very narrow emargination. Propodeum with dorsal surface very little depressed, smooth and shining, very slightly cross-striate posteriorly. Posterior surface with a deep narrow furrow, ending at half its length from orifice, no keeled depression, angles with rather strong keels which curve inwards, shining moderately strongly and regularly striate. Sides shining, with fine rather close punctures and obsolete striae. First abdominal tergite with no furrow, spiracular area about twice as long as broad, apophyses rounded but rather strong, tergite at base two-thirds as wide as length of hind trochanter, two and a half times as wide at apex, nearly as long as hind femur + trochanter + coxa. Second tergite hardly longer than half the first, two and a half times as long as apical width. First tergite little, second very little contracted at apex. Seventh tergite with a very short keel, projecting beyond the apex as a hook. Sternites bare.

Type. ♂, Tabernilla, Canal Zone, Panama, 23 July '07 (*A. Busck*) (W.).

T. bogotense sp. n.

Female. Black, mandibles, tegulae, fore tibiae and tarsi, sides of first abdominal tergite, basal two-thirds of second segment, reddish-yellow. Base of antennae pitchy beneath. Wings hyaline, darker in radial cell. Pubescence silvery. Length 10 mm.

Occiput smooth and shining, hardly punctured, somewhat impressed. Eyes hardly closer at clypeus than on occiput where separated by a distance nearly equal to length of antennal segments 2 + 3. Ocelli separated by one-quarter their diameter from eyes, from one another by three-quarters their diameter. Vertex dull, densely alutaceous, with sparse, shallow punctures separated by 1–2 diameters, distinctly impressed centrally. Supraantennal keel moderately raised with a fine keel in front and an elongate truncation behind. Limiting keels of antennal scrobes moderately strong but shorter than scape of antennae. Antennal sockets separated by nearly their diameter. Antennae with scape one and two-thirds times longer than greatest width, 3 four times longer than broad, distinctly shorter than 4 + 5, 4 about as long as 5, about two and a half times longer than broad, remaining segments distinctly longer than broad, 12 two and a half times as long as broad. Clypeus with a broad polished margin and a faint apical emargination. Occipital keel incomplete, horizontal space behind buccal cavity very narrow. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel with small teeth at sides and centre, obliterated between. Lateral tubercle of pronotum not very strong but sharp-edged. Pronotal collar strongly bordered. Mesopleuron shining, obsoletely punctured, prepectus with traces of dorsal keel. Pleural suture extending half-way up pleuron. Mesonotum and scutellum very shining, hardly punctured, latter flat. Metanotum smooth, flat, lateral lobes striate, posterior margin distinct raised and hyaline, depressions large, not deep. Area beneath metapleural keel defined. Metasternum with a narrow emargination. Propodeum with dorsal area flat, shining, unsculptured. Posterior surface with a moderately deep furrow, ending distinctly before the deep keeled depression, angles without keels, with very weak and irregular striae. Sides shining, unsculptured. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses very weak, tergite a little narrower than length of hind trochanter, one and a half times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and two-thirds times as long as width at apex. First and second tergites both distinctly contracted at apex. Sixth tergite keeled on apical half. Sternites bare.

Type. ♀, Colombia, Bogota (*Lindig*) (B.). Paratype. ♀, Peru, Pevas (V.). In the paratype the striae of the angles of the propodeum are a little stronger.

T. bogotense very nearly intergrades with *T. nitidum* Sm., but the presence of a ventral prepectal keel and the more prominent angles of the pronotal collar distinguish it.

Subgroup of *T. vagum* Sm.

Pronotal collar not bordered, angles rather prominent. Pronotal tubercles distinct, sharp-edged (weaker in *T. vagulum* sp. n.). Prepectus with no ventral keel, usually no dorsal one. Proepisternal keel variable. Pleural suture developed or not. Clypeus one to one and two-thirds times as long as least width between eyes below. Apex of clypeus at most feebly sinuate or emarginate. Inner dorsal keel of hind coxae extending to apex where approximated to emargination for reception of trochanters.

C. and S. America.

T. semiflavum sp. n.

Female. Black, antennae, lower half of clypeus, mandibles except apical third, mouthparts, prothorax except collar, tegulae, mesopleuron and sternum (except right at base of wings), metathorax below metapleural keel, narrow apical area of propodeum, legs, abdomen except dusky tinge towards apex of tergites, bright ochreous brown. Wings pale brown, a little ochreous tinged. Pubescence dense, brilliant golden. Length 15 mm.

Occiput shining, centrally impressed, on each side rather strongly raised. Eyes equally separated above and below, by a distance equal to two-thirds length of antennal segment 3. Ocelli separated by one-quarter their diameter from eyes, by two-thirds their diameter from one another. Vertex dull, finely coriaceous, with a strong central impression. Supra-antennal keel little raised with a small posterior truncation, defining a horseshoe-shaped area. Limiting keels of antennal scrobes not developed. Antennal sockets separated by two-thirds their diameter. Antennae with scape one and a half times as long as greatest width, 3 nearly six times as long as broad, 4 three and a half times as long as broad, remaining segments missing. Clypeus with apex bluntly rounded. Occipital keel not nearly completed but nearly meeting buccal cavity, horizontal space behind latter very narrow. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel traceable but rounded, more distinct at sides where it forms a rounded lobe. Angles of pronotal collar moderately prominent. Mesopleuron obsoletely and not very closely punctured, prepectus with no dorsal keel. Pleural suture not developed. Mesonotum and scutellum moderately shining, rather closely but exceedingly finely punctured, latter flat. Metanotum flat, scarcely punctured, lateral lobes striate and hairy, posterior margin not raised, depressions large, hair-filled. Area beneath metapleural keel defined. Metasternum with a broad, shallow, U-shaped emargination. Propodeum with dorsal area smooth, flat, unsculptured but defined by direction of pubescence. Posterior surface with a shallow furrow ending at half its length from orifice, just before the large shallow-keeled depression, angles without keels, coarsely striate. Sides obsoletely striate behind, almost unsculptured in front, not defined above. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses moderately strong, tergite at base nearly as broad as length of hind trochanter, one and two-thirds times as broad at apex, as long as hind femur + trochanter. Second tergite hardly longer than half as long as first, one and two-thirds times as long as broad at apex. First tergite rather strongly, second moderately contracted at apex. Sixth tergite unkeeled. Sternites bare.

Type. ♀, Bolivia (V.).

T. emdeni sp. n.

Female. Black, antennal segments 1–3, mandibles, palpi, tegulae, pronotal collar posteriorly and tubercles, fore legs except base of coxae, base of trochanters, and cloud behind femora, mid legs except coxae and trochanters and dorsal streak on femora, hind legs except dorsal marks on coxae, trochanters and femora, sides and central streak on first abdominal tergite, basal half of second tergite, first abdominal sternite and basal half of second, yellowish-testaceous. Wings rather dark yellow-brown, darker on costal half. Pubescence bright brassy. Length 13 mm.

Occiput shining, finely punctured, strongly impressed. Eyes equally separated above and below, on occiput by a distance hardly greater than length of antennal segment 4. Ocelli separated by less than one-quarter their diameter from eyes, by hardly more than half their diameter from one another. Vertex densely alutaceous, dull, with close shallow punctures, central furrow distinct. Supraantennal keel very weak with a long, narrow, posterior truncation. Limiting keels of antennal scrobes not developed. Antennal sockets separated by three-quarters their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 four and a half times as long as broad, nearly as long as 4 + 5, 5 a little longer than 4, nearly three times as long as broad, 6–11 nearly twice as long as broad, 12 a little longer. Clypeus with apex very feebly emarginate. Occipital keel incomplete, horizontal space behind buccal cavity distinct. Tempora beneath shining, finely and sparsely punctured. Stipes of maxillae shining, finely punctured. Proepisternal keel sharp-edged forming an obtuse tooth at centre only. Angles of pronotal collar hardly prominent. Mesopleuron shining, finely and sparsely punctured, prepectus with a dorsal furrow. Pleural suture hardly developed. Mesonotum moderately shining, closely and finely punctured. Scutellum more sparsely punctured, with a faint central depression. Metanotum somewhat convex, hardly punctured, lateral lobes striate, posterior margin not raised, preceded by large depressions. Area beneath metapleural keel not defined. Propodeum with dorsal surface shining, flat, with obsolete transverse striae. Posterior surface with a shallow but well-defined furrow ending in a very deep keeled depression, angles without keels, shining, very finely striate. Sides shining, closely and finely punctured. First abdominal tergite with no furrow, spiracular area one and a third times longer than broad, apophyses very weak, tergite at base nearly as broad as length of hind trochanter, twice as broad at apex, as long as femur + trochanter. Second tergite two-thirds as long as first, one and a third times longer than broad at apex. First tergite rather strongly, second moderately contracted at apex. Sixth tergite not keeled. Sternites bare.

Type. ♀, Peru, 10 Jan. '04 (*W. Schnuse*) (D.).

T. laevifrons Smith (1873).

Female. Black, antennae with segments 1–4 and 11 and 12, apex of clypeus, mandibles except the tip, legs except fore coxae, and whole abdomen, yellowish-red. Mesosternal and metasternal posterior processes red. Wings fusco-hyaline with a faint yellowish tinge. Pubescence bright golden. Length 16 mm.

Occiput shining, hardly punctured, with slight prominences behind the lateral ocelli, little depressed between them. Eyes distinctly closer together at clypeus than on occiput, where separated by a distance only as great as length of antennal segment 4. Ocelli separated by less than a quarter their diameter from eyes, by half their diameter from one another. Vertex dull, alutaceous, with shallow moderately close punctures, with distinct longitudinal impression. Supraantennal keel little raised, obliquely and rather narrowly truncate behind. Limiting keels of antennal scrobes fine, as long as antennal scape. Antennal sockets separated by half their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 five times as long as broad, slightly shorter than 4 + 5, 4 longer than 5, which is about two and a half times as long as broad, remaining segments all much longer than broad, 12 about one and a half times as long as 11. Clypeus with slight apical emargination. Occipital keel incomplete, horizontal space behind buccal cavity narrow. Tempora beneath shining, rather finely and sparsely punctured. Stipes of maxillae shining, almost unpunctured. Proepisternal keel sharp-edged, with strong tooth at sides only. Angles of pronotal collar distinctly prominent. Mesopleuron sparsely and finely punctured, prepectus with no dorsal furrow. Pleural suture extending nearly half-way up the pleuron. Mesonotum and scutellum very shining, very sparsely and finely punctured, the latter flat. Metanotum flat, hardly punctured, lateral lobes striate, posterior margin not raised and hyaline, depressions shallow. Area beneath metapleural keel not defined. Metasternum with a small U-shaped emargination. Propodeum with dorsal surface flat, almost unpunctured with a few subobsolete striae on disc. Posterior surface with a furrow to orifice, keeled depression defined at sides only, angles with short keels strongly curved inwards, with obsolete striae. Sides finely and moderately closely punctured. First abdominal tergite with no furrow, spiracular area two and a half times as long as broad, apophyses forming a distinct projection, tergite parallel-sided for most of its length, at base hardly more than half as broad as length of hind trochanter, about twice as broad at apex, as long as hind femur + trochanter + coxa. Second tergite three-fifths as long as first, three times as long as broad at apex. First and second tergites both rather strongly contracted at apex. Sixth tergite not keeled. Sternites bare.

Specimens seen: Type. ♀, Brazil, Ega (L.). ♀, British Guiana (L.).

T. vagum Smith (1873).

Female. Black, antennae with apex of segments 2–4 reddish tinged. Apex of clypeus, mandibles, tegulae, apex of all femora and hind pair beneath, fore tibiae and tarsi, mid tibiae and basitarsi, base of hind tibiae, basal part and narrow apical ring of each abdominal tergite, greater part of sternites, reddish-brown. First abdominal tergite with a more or less distinct discal pale streak. Wings fusco-hyaline, radial cell darker. Pubescence very pale brassy. Length 12 mm.

Occiput smooth, shining, raised behind ocelli, centrally impressed. Eyes equally separated above and below, at occiput by a distance equal to length of antennal segment 3. Ocelli separated by one-quarter of their diameter from eyes, by two-thirds diameter from one another. Vertex dull, alutaceous, with close shallow punctures, central impression distinct. Supraantennal keel forming a rather strong tubercle, posterior truncation circular. Limiting keels of antennal scrobes fine, nearly as long as scape of antennae. Antennal sockets separated by their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 four and a half times as long as broad, shorter than 4 + 5, 4 longer than 5, which is about two and a half times as long as broad, remaining segments all somewhat longer than broad, 12 about one and a half times as long as 11. Clypeus with broad polished apex with a slight emargination. Occipital keel not quite reaching buccal cavity, space behind which is moderately broad. Tempora beneath shining, with sparse, fine punctures. Stipes of maxillae with fine sparse punctures. Proepisternal keel with very strong downwardly directed teeth at sides and centre, obliterated between them, teeth bearing fine pubescence. Angles of pronotal collar strongly prominent. Mesopleuron sparsely and finely punctured, prepectus with a dorsal keel extending half-way across it. Pleural suture extending half-way up pleuron. Mesonotum and scutellum finely and sparsely punctured, latter nearly flat. Metanotum flat, finely punctured, lateral lobes not striate, posterior margin raised and hyaline, preceded by shallow depressions. Area beneath metapleural keel not or hardly defined. Metasternum with a narrow emargination. Propodeum with dorsal surface flat, almost unsculptured. Posterior surface with a furrow to orifice, a distinct keeled depression, angles with very short keels, with strong regular striae. Sides finely and rather closely punctured. First abdominal tergite with no furrow, spiracular area one and two-thirds times as long as broad, apophyses rather strong, tergite at base about as wide as length of hind trochanter, one and a half times as wide at apex, a little longer than hind femur + trochanter. Second tergite half as long as first, one and a half times as long as broad at apex. Sixth tergite not keeled. Sternites bare.

Specimens examined: Type. ♀, São Paulo, Brazil (L.); ♀, Surinam, Dutch Guiana, 1899 (*Frühstorfer*) (V.); ♀, Trinidad River, Panama, 9 May '11 (*A. Busck*) (W.). The last-mentioned female is darker in colour and the striae of the angles of the propodeum are stronger, sparser and more regular.

T. vagulum sp. n.

Male. Black, dorsal surface of segments 3–5 of antennae, ventral surface of segments 2–7, yellowish-brown. Mandibles, tegulae, fore tibiae and tarsi very pale yellow-brown, mid basitarsi whitish. Sides and venter of first abdominal segment, base, sides and venter of second, narrow base of third tergite and basal half of third sternite, obscurely reddish-brown. Wings subhyaline, darker along costa and at apex. Pubescence very light brassy. Length 9·5 mm.

Occiput shining, hardly punctured, raised behind ocelli, strongly impressed between. Eyes a little closer at clypeus than at occiput where separated by a little less than length of antennal segments 2 + 3. Ocelli touching eyes, separated from one another by nearly their diameter. Vertex dull, alutaceous, with close, not very large, flat-bottomed punctures, central impression rather strong. Supraantennal keel moderately strong with a fine dorsal keel anteriorly, posteriorly with an elongate truncation. Limiting keels of antennal scrobes strong, curving inwards and enclosing a quadrate area. Antennal sockets separated by half their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 three times as long as broad, a little shorter than 4 + 5, 4 nearly as long as 5, which is nearly twice as long as broad, remaining segments somewhat longer than broad, 13 twice as long as broad, as long as 11 + 12. Clypeus with a small central emargination and a still smaller one on each side. Occipital keel incomplete, horizontal space behind buccal cavity narrow. Tempora beneath shining, sparsely and finely punctured. Stipes of maxillae shining, finely punctured. Proepisternal keel with sharp, downwardly directed teeth at sides and centre, obliterated between them. Angles of pronotal collar moderately prominent. Mesopleuron finely and sparsely punctured, prepectus with no dorsal keel. Pleural suture extending half-way up pleuron. Mesonotum and scutellum shining, very finely and sparsely punctured, latter flat. Metanotum flat, unpunctured, lateral lobes not striate, posterior margin raised and hyaline, depressions nearly obsolete. Area beneath metapleural keel defined. Metasternum with a narrow slit-like emargination. Propodeum with dorsal surface nearly flat but somewhat depressed apically, shining, almost unpunctured. Posterior surface with a deep narrow furrow, ending in a sharp curved keel (convexity downwards) which is distinctly separated from the well-defined keeled depression, angles with distinct short keels, finely striated. Sides very finely and moderately sparsely punctured. First abdominal tergite with a short furrow, spiracular area one and a half times as long as broad, apophyses moderate, tergite at base somewhat narrower than length of hind trochanter, one and two-thirds times as broad at apex, about as long as hind femur + trochanter. Second tergite rather more than half as long as first, two and a quarter times as long as broad at apex. First tergite distinctly, second hardly contracted at apex. Seventh tergite with a keel, projecting beyond apex as a small hook. Sternites bare.

Type. ♂, Rio Frio, Magdalena, Colombia, 15 Oct. '27 (*Salt*).

A female, Cabima, Panama, 18 May '11 (*A. Busck*) (W.), may also belong to this species. The antennae are entirely dark, the fore tibiae have a dark dorsal streak, apex of mid basitarsus dark. The abdomen is missing after the second segment. The antennal segments are all proportionately a little longer.

T. gaucho sp. n.

Female. Black, tegulae and sides of abdominal tergites 1–2, testaceous tinged. Wings pale fuscous. Pubescence silvery. Length 18 mm.

Occiput shining, moderately closely and strongly punctured, not impressed. Eyes equally separated above and below, on occiput by a distance equal to length of antennal segment 4. Ocelli separated by half their diameter from eyes, by their diameter from one another. Vertex dull, subcoriaceous with close punctures which are only clearly distinguishable at sides. Supraantennal keel little raised bearing a very fine keel. Limiting keels of antennal scrobes not developed. Antennal sockets separated by three-quarters their diameter. Antennae with scape one and a half times as long as broad in middle, 3 five times as long as broad, about as long as 4 + 5, 4 about as long as 5, which is two and a half times as long as broad, 6–11 progressively shorter, but 11 still one and a half times as long as broad, 12 a little longer. Clypeus with a weak keel on apical half, a broad polished apex, margin sinuate, forming four very weak projections. Occipital keel meeting keel of buccal cavity, horizontal space behind latter hardly developed. Tempora beneath closely and strongly punctured. Stipes of maxillae shining with few punctures. Proepisternal keel sharp-edged forming a tooth at centre. Angles of pronotal collar not prominent. Mesopleuron closely and rather strongly punctured, prepectus with no dorsal keel. Pleural suture hardly developed. Mesonotum moderately shining, strongly and closely punctured. Scutellum more sparsely punctured, flat. Metanotum convex shining, finely punctured, lateral lobes densely hairy, preceded by large hair-filled depressions. Area beneath metapleural keel not defined. Metasternum with a narrow emargination. Propodeum with dorsal surface flat, shining, closely and finely punctured with a few striae posteriorly. Posterior surface with a deep furrow, shallowing out a little before orifice, no keeled depression, angles with no keels, closely striate, dull. Sides shining, not very closely punctured. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses hardly developed, tergite at base as wide as length of hind trochanter, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and two-thirds times as long as broad at apex. First tergite strongly, second little contracted at apex. Sixth tergite with a short keel at apex. Sternites bare.

Type. ♀, Argentina, Chaco de Santiago del Estero, near Icano, Mistol Paso, Jan. to June '12 (*E. R. Wagner*) (P.). This is perhaps an aberrant member of the group of *T. punctulatum* Taschbg.

T. lynchi Brèthes (1913, p. 154), Argentina, Chaco, is perhaps an earlier name for this species.

SUBGROUP OF *T. NITIDUM* SM.

Pronotal collar more or less bordered (fig. 10), angles not prominent. Pronotal tubercles moderately strong, sharp-edged. Prepectus with no ventral keel, dorsal keel present or absent. Proepisternal keel distinct and sharp, usually with one or two teeth. Pleural suture well developed. Clypeus one and a quarter to one and a half times as long as least width between eyes below, apex slightly emarginate (more strongly in *T. rubrocinctum* Pack.). Hind coxae with a moderately strong inner dorsal keel to apex where it is approximated to emargination for reception of trochanters.

America.

T. melanopteron sp. n.

Female. Black, tegulae, four hind tibiae and tarsi (sometimes), sides of first two abdominal tergites reddish tinged (base of second sometimes red). Wings fuscous or yellowish, especially base and costa. Pubescence silvery, that of the face more brassy. Length 15 mm.

Occiput shining, closely and rather strongly punctured. Eyes a little closer together at clypeus than on occiput, where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by their diameter from eyes, by a little more from one another. Vertex coarsely and confluently punctured, central impression weak. Supra-antennal keel obsolete or nearly. Limiting keels of antennal scrobes subobsolete. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 four and a half times as long as broad, about as long as 4 + 5, which are twice as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus a little produced in centre and faintly emarginate. Occipital keel incomplete, not quite reaching keel defining buccal cavity, behind which there is almost no horizontal space. Tempora beneath rather closely and strongly punctured. Stipes of maxillae smooth and shining. Procpisternal keel sinuate, forming a blunt tooth at centre and a rounded lobe at sides. Mesopleuron strongly and closely punctured, prepectus with no dorsal keel. Pleural suture often weak in the male. Mesonotum strongly and subconfluently punctured, dull. Scutellum strongly and closely punctured, flat. Metanotum flat, closely and finely punctured, lateral lobes striate, posterior margin with a broad hyaline edge, depressions large and deep. Area beneath the metapleural keel scarcely defined. Metasternum with a small V-shaped emargination. Propodeum with dorsal surface flat, obsoletely punctate-striate, laterally closely punctured. Posterior surface with a shallow furrow to orifice, a moderately well-defined keeled depression, angles with no keels, coarsely striate. Sides very closely and coarsely punctured. First abdominal tergite with very slight furrow, spiracular area a little longer than broad, apophyses very weak, tergite at base a little broader than length of hind trochanter, one and a third times as broad at apex, not quite as long as hind femur + trochanter. Second tergite three-fifths as long as first, one and a quarter times longer than broad at apex. First tergite moderately, second little contracted at apex. Sixth tergite not keeled. Sternites bare.

Male. Antennae with segment 13 one and a half times as long as 12. Centre of clypeus (fig. 48) a little produced, with two small teeth defining an emargination on each side of which is another minute emargination. Seventh tergite with a shining central keel.

The species is only known from the Argentine, apart from one record from the adjoining state of Bolivia and two, curiously enough, from the Amazons. As the colour is somewhat variable, the distribution of the forms is recorded separately below.

(1) Abdomen almost entirely black. Wings fuscous with costa darker.

Type. ♀, Argentina (L.). Allotype. ♂, Argentina, La Rioja (*A. de W. Bertoni*) (L.). Paratypes. *Bolivia :* ♂, Tarija, Cordova (*Hermann*) (B.). *Argentina :* ♂, La Rioja (*Giacomelli*) (W.); ♂, La Rioja, coll de Gaulle (P.); ♂, Mendoza, 5 Jan. '27 (*F. and M. Edwards*) (L.); ♂, Tucuman, Est. Exp., 22 Nov. '11 (*A. H. Rosenfeld*), A.C. no. 23 (W.); 2 ♂♂ (W.); ♂, S. Chaco (P.); 7 ♂♂, 3 ♀♀, Santiago del Estero, near Icano, '09 (*E. R. Wagner*) (P.); 6 ♂♂, with the same data and the note " *Trypoxylon* ayant etabli ses cellules dans les alveoles d'un nid de Poliste " (P.); 3 ♂♂, Santiago del Estero, 25 k. N. of Icano, ii '09 and i '04 (*E. R. Wagner*) (P.); ♀, Santiago del Estero, Troncal, 40 k. W. of Salaviba, '09 (*E. R. Wagner*) (P.); ♀, Parana (*Reimoser*) (V.).

(2) Abdomen with the base of the second tergite red. Wings fuscous with the costa darker.

Argentina : ♂, Anguinan, Chilecito, 13 June '27, swept in orchard (*M. Kisliuk Jr.*) (W.); ♀, Mendoza (V.).

(3) Abdomen black. Wings yellowish, especially along the costa.

Brazil : ♂, Amazons (*Cristofori*) (V.). *Argentina :* ♂, Punin, Dec. '25 (*Steinbach*) (B.); ♂, San Rafael, Mendoza, '06 (*A. Tournquer*) (P.); ♂, Sta. Rosa, Mendoza, 17 Jan. '05 (V.); ♂, Poterillos, Mendoza (*Reimoser*) (V.).

(4) Abdomen with base of second tergite red. Wings yellowish, especially along the costa.

Brazil : ♂, Amazons (*Cristofori*) (V.). *Argentina :* ♀, Mendoza, 13 Nov. '06 (*Jensen-Haarup*) (B.); ♀, Sta. Rosa, 17 Jan. '05 (*Jensen-Haarup*) (B.); ♀, Sta. Rosa, Mendoza, 28 Feb. '05 (V.); ♂♀, Salta, 2500 m. (V.).

T. jörgenseni Brèthes (1910, p. 284), Argentina, Chacras de Coria, may be an earlier name for this species.

T. fractum sp. n.

Female. Black, apex of mandibles pitchy; tegulae, sides of first abdominal tergite, sides and base of second, base of second sternite, reddish. Wings hyaline, darker along costa. Pubescence silvery. Length 12 mm.

Occiput shining, irregularly punctured, raised behind ocelli, with a well-defined central furrow. Eyes equally separated above and below, on occiput by a distance a little greater than length of antennal segment 3. Ocelli separated by one-quarter their diameter from eyes, by their diameter from one another. Vertex closely, shallowly but rather coarsely punctured, dull, alutaceous. Supraantennal keel moderately strong, truncate posteriorly. Limiting keels of antennal scrobes strong but short, diverging. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times as long as broad, shorter than 4 + 5, 4 a little longer than 5, 5 nearly two and a half times as long as broad, remaining segments all somewhat longer than broad, 12 one and a half times longer than 11. Clypeus with a very weak central emargination. Occipital keel nearly complete, horizontal space behind buccal cavity very narrow. Tempora beneath finely and sparsely punctured. Stipes of maxillae shining, very sparsely punctured. Proepisternal keel sharp, with a broad tooth at sides and a smaller one at centre. Mesopleuron shining, moderately closely and strongly punctured, prepectus with a short dorsal keel. Mesonotum coarsely and subconfluently punctured, dull, alutaceous. Scutellum flat, closely and finely punctured, shining. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions shallow. Area beneath metapleural keel defined. Metasternum with a small U-shaped emargination. Propodeum with dorsal surface somewhat depressed posteriorly, finely and regularly cross-striate. Posterior surface with a shallow furrow to orifice, no keeled depression, angles without keels, strongly and regularly striate. Side striate postero-dorsally, finely and closely punctured antero-ventrally. First abdominal tergite with no furrow, spiracular area hardly longer than broad, apophyses weak and rounded, tergite as wide at base as length of hind trochanter, one and two-thirds times as wide at apex, as long as hind femur + trochanter. Second tergite a little longer than half length of first, nearly twice as long as wide at apex. First tergite moderately, second little contracted at apex. Sixth tergite with a keel on apical half. Sternites smooth and bare.

Type. ♀, Brazil (O.). Paratype. ♀, Brazil, F. Smith coll. (L.). In the paratype the mesonotal punctures are a little less close and the ocelli are separated by one-third their diameter from eyes.

T. alutaceum sp. n.

Female. Black, tips of mandibles, tegulae, narrow base of second and sides of first two abdominal tergites, reddish. Wings hyaline, costal half as far as tip of radial cell yellowish-brown tinged. Pubescence pale brassy. Length 11·5 mm.

Occiput dull and very finely coriaceous, weakly impressed. Eyes equally separated above and below, on occiput by a distance rather less than length of antennal segment 3. Ocelli separated by half their diameter or rather less from eyes, by one and a third diameters from one another. Vertex finely coriaceous, absolutely dull, with moderately close and fine, flat-bottomed punctures, central impression hardly developed. Supraantennal keel weak, truncate in a horseshoe-shape behind. Limiting keels of antennal scrobes very short, as long as width of scape, but strong. Antennal sockets separated by two-thirds their diameter. Antennae with scape one and a half times as long as greatest width, 3 about five times as long as broad, not quite so long as 4 + 5, 4 a little longer than 5 which is two and a half times as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus with apex a little upturned, scarcely emarginate. Occipital keel nearly complete, horizontal space behind buccal cavity very narrow. Tempora beneath moderately shining, faintly alutaceous, with sparse punctures. Stipes of maxillae smooth and shining. Proepisternal keel strong but forming a rounded lobe at sides only. Mesopleuron shining, with fine and sparse punctures, prepectus with dorsal keel extending half-way across. Mesonotum and scutellum absolutely dull, densely alutaceous, with moderately close shallow punctures. Metanotum flat, shining, finely punctured, scarcely striate, posterior margin hyaline, depressions deep. Area beneath the metapleural keel defined. Metasternum with a broad V-shaped emargination. Propodeum with dorsal surface a little depressed on disc, finely, subobsoletely cross-striate, not very shining. Posterior surface with a deep, rather narrow furrow extending to half its length from orifice, keeled depression weakly defined, angles with no keels, regularly and finely striate. Sides moderately shining, finely striate postero-dorsally, finely and closely punctured antero-ventrally (sometimes striate here also). First abdominal tergite with no furrow, spiracular area as long as broad, apophyses strong, tergite at base about as wide as length of hind trochanter, one and a half times as wide at apex, as long as hind femur + trochanter. Second tergite a little longer than half the length of first, one and a half times as long as broad at apex. First tergite little, second not contracted at apex. Sixth tergite with a keel on apical half. Sternites bare.

Male. Ocelli separated by one-quarter their diameter from eyes. Antennae with segment 13 twice as long as broad, shorter than 11 + 12. Clypeus with four weak, apical teeth. Scutellum not alutaceous. Sides of propodeum hardly striate. Seventh tergite with a flat, elongate-triangular area, somewhat truncate at apex.

Type. ♀, "Biske," Brazil (V.). Allotype. ♂, Brazil (L.). Paratypes. ♀, with the same data as type (V.); ♀, Brazil, Santa Catharina, Thersepolis (*Michaelis*) (B.); ♀, Brazil, St. João del Rey (*Sello*) (B.).

In the second paratype the wings are nearly hyaline, while in the third the costal half is dark brown.

T. opacum Brèthes (1913, p. 155), Argentina, Jujuy, may be an earlier name for this species.

T. collinum Smith (1856).

Female. Black, mandibles pitchy red, paler at base; segments 1–5 of antennae, proepisternum, pronotum, tegulae, legs except base of coxae, extreme apex of propodeum, and first two abdominal segments, bright red. Wings evenly suffused with moderately dark brown. Pubescence silvery. Length 12 mm.

Occiput rather dull, irregularly punctured, feebly impressed. Eyes equally separated at clypeus and on occiput where separated by a distance equal to rather more than length of antennal segment 3. Ocelli separated by one-quarter their diameter from eyes, by their diameter from one another. Vertex coarsely and confluently punctured, shining, central furrow nearly obsolete. Supraantennal keel rather strongly raised but with no fine keel, posterior truncation subcircular, as large as median ocellus. Limiting keels of antennal scrobes strong but short, as long as half diameter of antennal socket. Antennal sockets separated by two-thirds their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times as long as broad, shorter than 4 + 5, 4 a little longer than 5, three times as long as broad, remaining segments all distinctly longer than broad, 12 a little longer than 11. Clypeus with a small central emargination. Occipital keel strong, incomplete, horizontal space behind buccal cavity narrow. Tempora beneath shining, very sparsely but moderately strongly punctured. Stipes of maxillae shining, very finely and sparsely punctured. Proepisternal keel represented merely by a moderately strong tooth at sides. Mesopleuron strongly but not very closely punctured, prepectus with the dorsal keel extending half-way across. Mesonotum and scutellum shining, moderately closely and strongly punctured, the latter flat. Metanotum flat, very finely punctured, lateral lobes striate, posterior margin distinctly hyaline, depressions deep. Area beneath the metapleural keel defined. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface somewhat depressed discally posteriorly, with coarse striae, longitudinal at base, transverse at apex. Posterior surface with a deep narrow furrow, a little broader but no shallower below, extending to keeled depression which is defined above by a very strong keel, angles with keels very short, strongly striate. Sides strongly striate. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses very weak, tergite at base about as broad as length of hind trochanter, one and a quarter times as wide at apex, rather longer than hind femur + trochanter. Second tergite three-fifths as long as first, twice as long as wide at apex. First tergite considerably, second hardly contracted at apex. Sternites bare. Sixth tergite not keeled.

I have only examined the type of this species which is a female in the collection of the British Museum, St. John's Bluff, E. Florida (*E. Doubleday*). Smith had confused this species with *T. johannis* sp. n. (q.v.).

T. obidense sp. n.

Male. Black, antennae 4–6 beneath, mandibles, tegulae, basal half of second abdominal segment, reddish. Fore tibiae, except dorsal streak, basal quarter of mid and hind tibiae and annulations of all tarsi, pale brown. Wings hyaline, apex brown. Pubescence silvery. Length 10 mm.

Occiput shining, hardly punctured, rather deeply impressed. Eyes seen from in front unusually large and swollen, separation at clypeus only two-thirds what it is on occiput, where it is a little less than length of antennal segments 2 + 3. Ocelli separated by less than one-quarter their diameter from eyes, by nearly their diameter from one another. Vertex coarsely and confluently punctured, subrugose, dull, convex on either side of distinct central furrow. Supraantennal keel moderately raised, truncate posteriorly. Limiting keels of antennal scrobes moderately strong, longer than scape of antennae. Antennal sockets separated by two-thirds their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 four times as long as broad, as long as 4 + 5, 4 as long as 5, twice as long as broad, remaining segments a little longer than broad, 13 nearly twice as long as broad, shorter than 11 + 12. Clypeus with a slight central emargination filled in at a lower level. Occipital keel not quite complete, externally crenulate, horizontal space behind buccal cavity distinct, transversely depressed. Tempora beneath shining, rather sparsely and finely punctured. Stipes of maxillae shining, finely and sparsely punctured. Proepisternal keel sharp-edged, with a moderate tooth at sides and a smaller one at centre. Mesopleuron rather sparsely and finely punctured, prepectus with a complete keel. Mesonotum rather closely and finely punctured, scutellum more finely, flat. Metanotum flat, lateral lobes striate, with distinct raised, hyaline posterior margin, preceded by large shallow depressions. Area beneath metapleural keel strongly defined. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface with large central, triangular depressed area which is strongly striate, diagonally at base and transversely at apex, outside the area with fine striae and punctures. Posterior surface with a deep narrow furrow which ends below at a strong keel which defines the very large keeled depression which is half as long as the furrow, angles with distinct keels, moderately shining, with strong, irregular, clathrate keels. Sides rather dull, with irregular striae and fine punctures. First abdominal tergite with no furrow, spiracular area one and two-thirds times as long as broad, apophyses distinct, rounded, tergite at base nearly as wide as length of hind trochanter, one and a half times as wide at apex. Second tergite about half as long as first, one and two-thirds times as long as wide at apex. First tergite hardly, second not contracted at apex. Seventh tergite with an apical keel, projecting as a hook. Sternites bare.

Type. ♂, Brazil, Amazonas, Obidos, Jan. '06 (*Ducke*) (V.). Paratype. ♂, with the same data (V.).

T. orizabense sp. n.

Female. Black, tip of mandibles, tegulae, narrow basal ring to second abdominal tergite, reddish. Wings subhyaline, darker on costal half. Pubescence silvery, moderately dense. Length 13·5 mm.

Occiput finely punctured, scarcely impressed. Eyes hardly closer below than above, on occiput separated by a little more than length of antennal segments 2 + 3. Ocelli separated by two-thirds their diameter from eyes, by the same distance from one another. Vertex coarsely and confluently punctured, dull, more finely punctured near ocelli, central impression nearly obsolete. Supraantennal keel practically obsolete, but at level of posterior end of keel forming two small, approximated, thorn-like tubercles. Limiting keels of antennal scrobes short, parallel, enclosing an area nearly twice as broad as long. Antennal sockets separated by their diameter. Antennae with scape one and a half times as long as greatest width, 3 about six times as long as broad, a little shorter than 4 + 5, 4 a little longer than 5, 5 two and a third times longer than broad, remaining segments all distinctly longer than broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus with apex smoothly rounded. Occipital keel not quite reaching buccal cavity, horizontal space behind latter very narrow. Tempora beneath shining, rather sparsely and finely punctured. Stipes of maxillae moderately shining, coarsely and closely punctured. Proepisternal keel nearly straight, rounded but forming a distinct lobe at sides. Angles of pronotal collar not prominent. Mesopleuron shining, obsoletely but moderately closely punctured, prepectus with no dorsal keel. Pleural suture extending about one-third of the way up pleuron. Mesonotum and scutellum shining, closely but obsoletely punctured, latter flat. Metanotum flat, shining and almost unpunctured, lateral lobes striate, posterior margin not raised, depressions deep. Propodeum with dorsal surface dull, flat, whole surface regularly cross-striate. Posterior surface with a shallow furrow separated from orifice by two-thirds its length, with a deep keeled depression, angles without keels, closely and regularly striate. Sides moderately shining, striate postero-dorsally, finely and closely punctured antero-ventrally. Whole of propodeum with long outstanding hairs, but surface quite visible. First abdominal tergite with no furrow, spiracular area a little longer than broad, apophyses hardly developed, tergite at base as broad as length of hind trochanter, one and a half times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, about twice as long as broad at apex. First very strongly contracted at apex leaving a small apical ring at a lower level than rest of tergite, second rather strongly contracted at apex. Sixth tergite not keeled. Sternites bare.

Male. Ocelli separated by nearly their diameter from eyes. Antennae with scape about as long as broad (being unusually broad) apical margin angulated, 3 four and a half times as long as broad, as long as 4 + 5, less than twice as long as broad, 8 and 9 quadrate, 10–12 transverse, 13 three times as long as broad, as long as 9 + 10 + 11 + 12. Clypeus at apex with a deep narrow central emargination defined by strong teeth outside which on each side is a smaller tooth. Mesopleuron rather more obsoletely punctured. Ventral surface of hind trochanter keeled, raised into a high lamella from base to near apex, lamella quite rounded in profile. Seventh tergite with an apical keel, projecting beyond apex as a hook.

Type. ♀, Orizaba, Mexico, June (V.). Allotype. ♂, Orizaba, Mexico, '71 (*Bilimek*) (B.). Paratype. ♀, Orizaba, 1862 (*Biart*) (P.).

This species may be recognised at once by the peculiar character of the supraantennal keel, but a high magnification is required to make this out.

T. rubrocinctum Packard (1867).

Male. Black, mandibles, apical part of tegulae, mid and hind tarsi, sides of first abdominal tergite, base and sides of second, reddish. Fore tibiae and tarsi reddish tinged. Base of mid basitarsus whitish. Wings hyaline, infuscate in radial cell and at apex. Pubescence silvery. Length 11 mm.

Occiput centrally depressed, shining, unpunctured. Eyes equally separated above and below, on occiput by a distance equal to length of antennal segment 3. Ocelli separated by one-quarter their diameter from eyes, by their diameter from one another. Vertex coarsely and confluently punctured, central impression obsolete. Supraantennal keel strongly raised, with a fine dorsal keel, posteriorly with a subcircular truncation. Limiting keels of antennal scrobes hardly developed. Antennal sockets separated by two-thirds their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times as long as broad, nearly as long as 4 + 5, 4 as long as 5, two and a quarter times as long as broad, remaining segments all a little longer than broad, 13 a little longer than 12. Clypeus with central half projecting, shallowly emarginate, projection truncate on each side of emargination. Occipital keel meeting keel defining buccal cavity, behind which is a narrow horizontal space. Tempora beneath shining with very sparse, rather large punctures. Stipes of maxillae smooth and shining. Proepisternal keel sinuate, sharp at sides but dying away towards centre. Mesopleuron shining very sparsely and rather finely punctured, prepectus without a dorsal keel. Mesonotum and scutellum moderately strongly and sparsely punctured, latter flat. Metanotum flat, hardly punctured, lateral lobes striate, posterior margin not raised, preceded by shallow depressions. Area beneath metapleural keel defined. Metasternum invisible. Propodeum with dorsal area somewhat depressed, especially posteriorly, punctured with obsolete striae and moderately strong punctures. Posterior surface with a deep narrow furrow ending in a keeled depression, angles with very short keels, coarsely striate. Sides rather coarsely and not very closely punctured. First abdominal tergite with no furrow, spiracular area a little longer than broad, apophyses rather weak, tergite as wide at base as length of hind trochanter, one and a half times as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, nearly twice as long as broad at apex. First tergite hardly, second not contracted at apex. Seventh tergite with a keel which projects beyond the apex as a hook. Sternites bare, simple.

Specimens seen: ♂, New York State, Ithaca, 14 July '96 (L.). (det. Bradley).

T. mendozanum sp. n.

Female. Black, mandibles, tegulae, sides of first abdominal tergite, sides, basal third and sternite of second, reddish-yellow. Wings hyaline. Pubescence silvery. Length 12 mm.

Occiput shining, sparsely punctured, centrally impressed. Eyes rather nearer together at clypeus than on occiput, where separated by a distance equal to length of segments 2 + 3 of antennae. Ocelli separated by one-third their diameter from eyes, by one and a third diameters from one another. Vertex coarsely and confluently punctured, central furrow weak. Supraantennal keel subobsolete, rather broadly truncate posteriorly. Limiting keels of antennal scrobes fine, two-thirds as long as scape of antennae. Antennal sockets separated by nearly their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times as long as broad, a little shorter than 4 + 5, which are a little more than twice as long as broad, remaining segments all distinctly longer than broad, 12 a little longer than 11. Clypeus with a slight apical emargination. Occipital keel incomplete but nearly meeting keel defining buccal cavity, behind which there is no horizontal space. Tempora beneath sparsely and finely punctured, shining. Stipes of maxillae finely punctured, shining. Proepisternal keel with a strong tooth at sides and centre, a little sinuate between them. Mesopleuron moderately strongly and closely punctured, prepectus with no dorsal keel. Mesonotum and scutellum shining, moderately strongly and densely punctured, the latter flat. Metanotum flat, shining, nearly hidden by pubescence, lateral lobes striate with a hyaline posterior margin, depressions shallow. Area beneath metapleural keel weakly defined. Metasternum with a small U-shaped emargination. Propodeum with dorsal area flat, finely striate, rather dull. Posterior surface with a shallow furrow to orifice, keeled depression weak, angles rather strongly striate, keels obsolete. Sides rather strongly striate. First abdominal tergite with a short furrow, spiracular area a little longer than broad, apophyses weak, tergite at base as wide as length of hind trochanter, one and a half times as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and three-quarter times as long as wide at apex. First and second tergites little contracted at apex. Sixth tergite with a smooth central line. Sternites bare.

Male. Antennal segments 3–6 more or less reddish, especially beneath. Ocelli separated by one-quarter their diameter from eyes. Antennae with segment 13 twice as long as broad. Apex of clypeus with a rather deep emargination defined by small teeth. Seventh tergite finely keeled, keel projecting as a hook.

Type. ♀, Argentina, Mendoza (L.). Allotype. ♂, Argentina (L.). Paratypes. ♂, Argentina (L.); 3 ♂♂, 4 ♀♀, Argentina, Prov. Santiago del Estero, near Icano, May '09 (*E. R. Wagner*) (P.). *T. platense* Brèthes (1913, p. 155), Buenos Aires, may be an earlier name for this species.

T. aurifrons Shuckard (1837).

(= *T. ornatum* Smith (1856); *T. latiornatum* Cameron (1912)).

Female. Black, base of mandibles, tegulae, fore tibiae, base of mid tibiae, sides and venter of first abdominal segment, basal half of tergite, sides and venter of second, reddish-brown; antennae with segments 2–4 and more or less of 5, yellowish-brown; fore tarsi, base of hind tibiae, hind tarsi more or less pale tinged. Wings subhyaline, darker along costa. Pubescence bright brassy (at least on face and pronotal collar). Length 13–15 mm.

Occiput shining, sparsely punctured, hardly impressed. Eyes hardly separated by more at clypeus than on occiput, where separated by a distance equal to length of segments 2 + 3 of antennae. Ocelli separated by rather less than half to two-thirds their diameter from eyes, by their diameter from one another. Vertex dull, coarsely and confluently punctured, more or less rugose, central depression very weak. Supraantennal keel very weak, posterior truncation forming a narrow horseshoe-shaped area. Limiting keels of antennal scrobes short, but very strong, enclosing an area about twice as broad as long. Antennal sockets separated by nearly their diameter. Antennae with scape one and a half times as long as greatest width, 3 five times as long as broad, nearly as long as 4 + 5, 4 as long as 5, two and two-thirds times as long as broad, remaining segments all distinctly longer than broad, 12 one and a half times as long as 11. Clypeus with a small central emargination. Occipital keel incomplete, nearly meeting keel defining buccal cavity, behind which there is almost no horizontal space. Tempora beneath shining, closely and rather finely punctured. Stipes of maxillae smooth and shining. Proepisternal keel hardly sharp-edged, not produced into a tooth. Mesopleuron shining, finely and not very closely punctured, prepectus with a dorsal keel extending half-way across. Mesonotum and scutellum shining, finely and moderately closely punctured, latter flat. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions small. Area beneath metapleural keel defined. Metasternum with a small V-shaped emargination. Propodeum with dorsal surface flat, finely and rather closely punctured. Posterior surface with furrow becoming shallow below, deep as far as two-thirds of its length from orifice, keeled depression scarcely defined, angles with short keels, irregularly striate. Sides shining, finely and not very closely punctured. First abdominal tergite with a short furrow, spiracular area nearly twice as long as broad, apophyses rather strong though rounded, tergite at base as wide as length of hind trochanter, twice as wide at apex, as long as hind femur + trochanter. Second tergite half as long as first, one and a half times as long as wide at apex. First tergite strongly, second little contracted at apex. Sixth tergite not keeled. Sternites bare.

Male. Pale markings usually rather more developed. Ocelli separated by half their diameter from eyes or less. Antennae thicker, with 13 one and a half times as long as 12. Central emargination of clypeus deeper, with a small tooth on each side of it. Proepisternal keel produced into a tooth at sides and an obsolete one at centre. Seventh tergite keeled, the keel projecting as a small hook.

Specimens seen : Shuckard's type is in the collection of the British Museum (according to the original description), but it has never been so marked. Possibly the specimen without locality label, mentioned below, is the actual specimen.

Colombia : ♀, Lake Sapatoza Region, Chiriguana district, Sept. Oct. '24 (*C. Allen*) (L.). *British Guiana :* ♂ (type of Cameron's *latiornatum*) ; ♂, Rockstone, 29 July '21 (*G. E. Bodkin*) (L.). *Brazil :* ♂ (Smith's type of *ornatum*) (L.) ; 2 ♀♀, Para (L.) ; ♀, Mt. des Orgues, Prov. Rio de Janeiro, July '02 (*E. R. Wagner*) (P.) ; ♂♀, Natterer (V.) ; ♀, Sello (B.) ; ♀, Uberaba, '00 (*Draenert*) (V.). *Paraguay :* ♀, Asuncion, Sapuuzay, 12 Jan. '05 (*J. D. Anisits*) (det. Strand as *T. fugax*) (B.). No locality : ♂ (L.).

Normally the present species is quite distinct from *T. nitidum* Sm. The latter, however, has certain colour varieties (especially in the male) which resemble *T. aurifrons.* The structural distinctions also appear to be somewhat variable. The separation of the ocelli from the eyes varies in the female from rather less than $\frac{1}{2}$ to $\frac{2}{3}$ a diameter, in the male from $\frac{1}{3}$ to $\frac{1}{2}$. Nevertheless I believe that perhaps 80% of the specimens of *T. aurifrons* will be recognised by their large size alone.

T. nitidum Smith (1856).

(= *T. bahiae* Saussure (1867) ; *T. aztecum* Saussure (1867) ; *T. annulipes* Taschenberg (1875) ; *T. rufosignatum* Taschenberg (1875) ; *T. fulvispine* Cameron (1889)).

Female. Black, mandibles usually red ; tegulae pale ; base of tibiae and of tarsi often more or less pale ; abdomen with usually sides of tergite 1 and sides and base of 2, pale. Wings hyaline, with costal margin or apex, or both, more or less infuscate, rarely completely hyaline. Pubescence brassy or silvery. Length 9–13·5 mm. ♀ average 11·8, ♂ 10·8 mm.

Occiput smooth and shining, centre hardly impressed. Eyes hardly nearer at clypeus than on occiput where separated by a distance about equal to length of antennal segments 2 + 3. Ocelli separated by one-quarter their diameter from eyes, by one diameter from one another. Vertex coarsely and confluently punctured (very rarely more finely and sparsely, but even then punctures separated by less than their diameter), central furrow distinct. Supraantennal keel nearly obsolete. Limiting keels of antennal scrobes short and forming little more than tubercles on dorsal edge of sockets. Antennal sockets separated by nearly their diameter. Antennae with scape one and a half times as long as greatest width, 3 four and a half times as long as broad, shorter than 4 + 5, 4 subequal to 5, two and a half times as long as broad, remaining segments all longer than broad, 9–11 about one and a half times, 12 two and a half times as long as broad, somewhat longer than 11. Clypeus with a slight apical emargination, rarely with the emargination partially filled in or even absent. Occipital keel incomplete but nearly meeting keel defining buccal cavity, behind which the horizontal space is very narrow. Tempora beneath moderately shining, rather closely and finely punctured. Stipes of maxillae smooth and shining. Proepisternal keel sinuate forming a rather strong tooth at sides and a weaker one at centre. Mesopleuron shining, rather sparsely and finely punctured, prepectus with dorsal keel half crossing it. Mesonotum and scutellum shining, rather sparsely and finely punctured, the latter flat. Metanotum flat, finely striate, lateral lobes striate, posterior margin rather broadly hyaline, depressions shallow. Area beneath the metapleural keel defined. Metasternum with a small V-shaped emargination. Propodeum with dorsal surface shining, flat, finely and sparsely punctured with traces of striae. Posterior surface with a deep furrow ending ventrally in a keeled depression, furrow below crossed by at most one or two microscopic, striae, angles not strongly striate, keels very weak and short. Sides finely and moderately closely punctured, more strongly above than below. First abdominal tergite with a very short furrow, spiracular area one and a half times as long as broad, apophyses subobsolete, tergite at base as wide as length of hind trochanter, about twice as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as wide as apical width. First tergite distinctly, second hardly contracted at apex. Sixth tergite with no keel. Sternites bare.

Male. Antennal segments 3–6 usually more or less pale beneath. Antennae with segment 13 twice as long as broad, shorter than 11 + 12. Apex of clypeus with a more distinct emargination, often defined by very weak teeth. Seventh tergite keeled, the keel projecting as a hook.

Specimens examined: Type. ♂, Brazil, Santarem (L.). I have also seen the types of the following forms which I regard as synonymous.

T. fulvispine Cameron. Type. ♀, Mexico, Teapa, Tabasco, Feb. (*H. H. Smith*) (B.C.A.).

T. bahiae Saussure. (Probable type.) ♀, Brazil, Bahia (G.).

T. aztecum Saussure. (Probable type.) ♀, Mexico, Tampico (G.).

T. rufosignatum Taschenberg. Type. ♂, Brazil, Lagoa Santa (H.).

T. annulipes Taschenberg. Type. ♂, Venezuela (H.).

T. californicum Saussure (1867, p. 77), Mexico, and *T. fallax* Fox (1897, p. 386), Brazil, may also be synonymous.

The range of *T. nitidum* includes Central America north to Mexico, Western S. America to Peru and Bolivia, Trinidad, Colombia to Brazil, Paraguay, and I have seen one specimen from Argentina (Tucuman). The species appears to be rather variable in the details of colour-pattern, and I have been at some pains to analyse the variation to see if it is at all geographical. In most cases the number of specimens from any one region is insufficient to come to any definite conclusion, but a few points of interest emerge.

(1) The mandibles are usually reddish; specimens with dark mandibles are :—1 ♀, Georgetown (Brit. Guiana); 1 ♂, Para; 2 ♀♀, Chanchomayo (Peru), and 1 ♂, E. Peru. It is just possible that there is a tendency in this direction in the region of Peru, but my material is insufficient.

(2) There is a tendency for the pubescence to be brassy in Colombia, Venezuela, the Guianas and Trinidad. Elsewhere the pubescence is usually or always silvery.

(3) The colour of the antennae shows a secondary sexual difference. They are entirely dark in 64 females, a little paler basally in 1, and definitely pale beneath the basal segments in 1. In the males they are entirely dark in 19 specimens, indistinctly paler in 1, definitely pale beneath the basal segments (2–8, usually 3–5 or 4–6) in 29, almost entirely pale beneath in 2. The basal segments are never conspicuously reddish both above and below as in *T. aurifrons* Shuck.

(4) Typically the abdomen has the sides of segments 1–2 and the base and often the venter of 2 pale. Occasionally the base of 3 is also pale. The darkest

specimens have the abdomen entirely black. On the whole the specimens with a dark abdomen tend to have dark legs, but the correlation is very imperfect.

(5) The legs are very variable in colour, and I have drawn up a list of fourteen different colour-forms. As will be seen later, these occur in different proportions in different parts of the range of the species.

A. Knees (*i.e.* junction of tibia and femur) dark, at most the fore knees pale.
- (1) Tarsi dark.
- (2) Mid basitarsus basally pale.
- (3) Four front basitarsi basally pale.
- (4) Four hind basitarsi basally pale.
- (5) Segments 1–3 of hind tarsi and 1–2 of mid tarsi basally pale.
- (6) All basitarsi basally pale.

B. Knees pale, at most the posterior pair scarcely so.
- (7) Tarsi dark.
- (8) Mid basitarsus basally pale.
- (9) Four front basitarsi basally pale.
- (10) Four hind basitarsi basally pale.
- (11) Segments 1–3 of hind tarsi and 1–2 of mid tarsi basally pale.
- (12) All basitarsi basally pale.
- (13) All basitarsi and second segments pale.

C. Fore tibiae pale except for a posterior mark; base and apex of mid tibiae pale; base of hind tibiae pale.
- (14) Front tarsi, mid basitarsus, base of hind basitarsus, annulations of four hind tarsi pale.

Some of these forms (viz. 3, 9, 14) are paler anteriorly than posteriorly; others (viz. 4, 5, 10, 11) are paler posteriorly than anteriorly. The remainder are neutral in this respect. These will be termed "fore," "hind" and "neutral" forms, respectively.

The material available, something over one hundred specimens, has been arranged under five geographical categories and the proportions of the various types examined with the following results. Owing to some specimens being imperfect, the same number is not always available for every character in a particular district.

Region I. (Mexico to Panama, Ecuador, Peru and Bolivia.)

Females.

Pubescence :—silvery in 20, intermediate 3, brassy 3.

Fore-wings usually with costal half more or less distinctly darker, sometimes apex also a little darker.

Abdomen :—dark in 10, light in 14.

Legs :—20 of form 1, 1 of 3, 1 of 4, 2 of 7, 1 of 9, 1 of 12 (*i.e.* forms all neutral or fore).

Males.

Pubescence :—silvery in 12, intermediate in 2.

Fore-wings as in female.

Abdomen :—dark in 3, light in 11.

Legs :—6 of form 1, 1 of 2, 1 of 3, 2 of 6, 1 of 9, 1 of 12 (*i.e.* forms all neutral or fore).

I believe the form found in this region, though not sharply defined, is a real stage in the formation of a geographical race, characterised by the colour of the fore-wings and the tendency for the pubescence to be silvery, the tarsi to be entirely dark and in any case of the fore tarsi to be lighter than the hind. The earliest name for this race is *T. aztecum* Saussure and *T. fulvispine* Cameron is a synonym.

The remaining specimens usually have the wings hyaline or with the apex darker. Often the costa is not at all dark or, if it is, the darkening is less extended and often restricted to the radial cell.

Region II. (Colombia, Venezuela and the Guianas.)

Females.

Pubescence :—silvery in 3, intermediate in 2, brassy in 11.

Abdomen :—dark in 3, light in 13.

Legs :—3 of form 1, 1 of 2, 1 of 4, 3 of 8, 3 of 9, 1 of 10, 3 of 12, 2 of 13 (*i.e.* 9 neutral, 6 fore and 2 hind).

Males.

Pubescence :—silvery in 2, intermediate in 3, brassy in 10.

Abdomen :—dark in 2, light in 12.

Legs :—1 of form 1, 1 of 3, 4 of 9, 2 of 10, 3 of 12, 2 of 13, 2 of 14 (*i.e.* 6 neutral, 7 fore and 2 hind).

In this region the pubescence appears to be more frequently brassy than elsewhere and the abdomen is usually light.

Region III. (Trinidad, B.W.I.)

Females.

Pubescence :—silvery in 1, brassy in 5.

Abdomen :—dark in 6.

Legs :—5 of form 1, 1 of 4 (*i.e.* neutral or hind).

Males.

Pubescence :—silvery in 2, intermediate in 5, brassy in 6.

Abdomen :—dark in 6, light in 7.

Legs :—1 of form 1, 1 of 3, 5 of 9, 2 of 10, 3 of 12, 2 of 13, 2 of 14 (*i.e.* 6 neutral, 8 fore and 2 hind).

The Trinidad form appears to resemble the Guiana form but has a darker abdomen.

Region IV. (Brazil.)

Females.

Pubescence :—silvery in 9, intermediate in 5, brassy in 3.

Abdomen :—dark in 5, light in 12.

Legs :—3 of form 1, 3 of 2, 1 of 4, 3 of 8, 6 of 12, 1 of 13 (*i.e.* 16 neutral and 1 hind).

Males.

Pubescence :—silvery in 6, intermediate in 2, brassy in 3.

Abdomen :—light in 7, dark in 3.

Legs :—2 of 1, 1 of 4, 1 of 8, 1 of 9, 6 of 12 (*i.e.* neutral 7, fore 1 and hind 1).

Region V. (Paraguay, Argentina.)

Females.

Pubescence :—silvery in 5.
Abdomen :—dark in 4, light in 1.
Legs :—1 of form 1, 3 of 5, 1 of 10 (*i.e.* 1 neutral and 4 hind).

Males.

Pubescence :—silvery in 3.
Abdomen :—dark in 3.
Legs :—6 (but with second segment also pale), 11, 12 (with segment 2 pale on hind tarsi) (*i.e.* 1 neutral and 2 hind).

This form seems rather distinct as far as the material goes. It is characterised by silvery pubescence, dark abdomen and the lighter hind tarsi.

I am well aware that the material available is inadequate to determine whether these regional differences are well-founded, especially when a vast heterogeneous area such as Brazil is represented by only 26 specimens. However, I think the results are suggestive and at least indicate that further study with more adequate material would be desirable. There appears to be a definite trend in leg-colour from Mexico where the fore legs are usually paler than the hind, to Paraguay, where the reverse is the case. Intermediate localities show a mixture of both forms.

T. majus sp. n.

Female. Black, mandibles and tegulae paler. Wings rather strongly infuscate. Pubescence silvery. Length 13–14 mm., average about 13·5 mm. Very closely allied to *T. nitidum* Smith, but besides the larger size differs as follows :—Limiting keels of antennal scrobes less developed. Dorsal keel of prepectus complete. Mesonotum much more strongly and closely punctured, the punctures separated by about twice their diameter. Furrow of posterior surface of propodeum crossed by a strong keel just above that defining the keeled depression.

Type. ♀, Brazil, Prov. Para, Obidos (*P. Kibler*) (B.). Paratypes. 2 other ♀♀ with the same data; 2 ♀♀, Obidos (*H. Rolle*) (V.); ♀, Cacao-Plantage, 50 m. from Obidos (*P. Kibler*) (B.).

This form is very closely allied to *T. nitidum*, but five females of that species also captured at Obidos show no tendency to intermediacy, and for the present I prefer to retain *T. majus* as a species rather than as a variety.

GROUP OF *T. FABRICATOR* SM.

Antennal sockets separated by a variable amount, from almost contiguous to a distance equal to their diameter. Limiting keels of antennal scrobes forming a straight or angulated transverse keel or undeveloped. Clypeus with apical margin usually simply curved, often rather projecting, often with dense outstanding hairs, especially in the female, height at least equal to, usually greater than (up to twice) least width between eyes below. Mandibles simple. Occipital keels variable, horizontal space behind buccal cavity distinct, though sometimes very narrow. Lateral tubercles of pronotum very variable; in some species nearly obsolete, in others produced into strong triangular processes (fig. 11). Angles of pronotal collar not bordered. Proepisternum with no definite keel, but the tubercle is sometimes very prominent and there may be a strong central tooth as well. Prepectus with no dorsal furrow, mesosternal keel present except in *T. silvestre* sp. n. Mesopleural suture not developed except in *T. cinctellum* sp. n., *T. cornigerum* Cam. and, to a very small extent, in *T. maidli* sp. n. Furrow in front of mid coxae variable in strength, rarely more than weakly crenate. Metapleural keel nearly straight, area defined or not. Lateral lobes of postnotum raised into high transparent lamellae (except in the female of *T. nitidissimum* sp. n.). Furrow joining depressions in metapleural-propodeal suture moderate to strong, very rarely crenate. Dorsal margin of orifice of propodeum projecting as a lamella, sharp-edged or a little downcurved, orifice not much broader than high. Fore coxae sometimes with strong apical bristles in the female, keels usually weak or absent, when present usually subparallel. Mid coxae with keel usually weak or absent, except near apex. Hind coxae with an inner dorsal keel of variable length, often placed somewhat diagonally, ventrally sometimes with a perforated tubercle in the female. Fore-wings with the costa distinctly produced beyond the radial cell, last section of M_{3+4} and im_1 set at an angle of 90–110°, last section of M_{1+2} 2–4 times the length of the penultimate. Two groups of hamuli on hind-wings consisting of 3–5 and 2–4 hooks each, the groups separated by 1½–4 (usually 2–3) times the length of the apical row. Sternites 2–5 or 3–5 more or less hairy, or at least with an apical triangular hairy area; usually several of sternites 2–5 with 2–3 bristles on each side. Eighth sternite of male variable, but posterior margin rounded or quite shallowly emarginate. Male genitalia with stipes and squama distinct, equally long and lying side by side. Other details of genitalia variable, but apparently usually a basal lobe to the volsellae (figs. 31 and 32; Pl. VIII, figs. 4–6).

Species usually rather small, often very slender, nearly always with some part of the body pale (except *T. nitidissimum* sp. n.). The group is mainly neotropical, but a few species are found in the United States.

The following species, known to me only from their descriptions, appear to belong to this group :—

T. insolitum Fox (1897, p. 384), Brazil. Near *T. fabricator* Sm.
T. succinctum Cresson (1865, p. 149), Cuba.
T. brasilianum Saussure (1867, p. 84), Bahia.
T. centrale Fox (1896, p. 267), Mexico.
T. rufimanum Spinola (1853, p. 59), Para.

T. rugiceps Dalla Torre (1897).

(= *T. rugifrons* Cameron (1889) *nec* Smith).

Male. Black, apex of clypeus, mandibles, pronotal tubercles, tegulae, base of four anterior tibiae narrowly, fore tarsi, yellowish. Basal half of mid basitarsi white. Wings hyaline. Pubescence silvery. Length 6·5 mm.

Occiput dull, finely alutaceous. Eyes much closer at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by half their diameter from eyes, by nearly their diameter from one another. Vertex dull, finely coriaceous, central impression very weak. Supraantennal keel a little prominent, bearing a very short, fine keel. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by rather more than half their diameter. Antennae with scape one and a half times as long as the greatest width, 3 three times as long as broad, shorter than 4 + 5, 4 and 5 subequal, nearly twice as long as broad, remaining segments progressively shorter and thicker, penultimate ones quadrate, 13 one and a half times as long as broad, one and a half times as long as 12. Clypeus with apex evenly rounded. Occipital keel complete, horizontal space behind the buccal cavity moderately broad. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel obsolete, tubercle a little prominent and sharp-edged anteriorly. Pronotum with centre and angles of collar not at all prominent, lateral tubercles strong, produced into a sharp, triangular lobe. Mesopleuron shining, very finely and rather sparsely punctured. Pleural suture not developed. Mesonotum dull, alutaceous, finely and rather closely punctured. Scutellum shining, finely punctured, nearly flat. Metanotum convex, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions deep. Area beneath the metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal area very weakly defined with a faint longitudinal central impression from which fine striae radiate outwards. Posterior surface with a rather narrow furrow which becomes very broad and shallow and nearly obliterated below, well defined above, keeled depression obsolete, orifice with dorsal margin sharp-edged, angles with no keels, finely striate. Sides finely striate, not defined above. First abdominal tergite with a very short furrow, spiracular area a little longer than broad, apophyses distinct but rounded, tergite at base rather narrower than length of hind trochanter, one and a quarter times wider at apex, as long as hind femur + trochanter + coxa. Second tergite two-thirds as long as first, four times as long as apical width. First distinctly, second not contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Specimens examined: Type. ♂, Mexico, Vera Cruz, Jan. '88 (*H. H. Smith*) (B.C.A.) (type of *T. rugifrons* Cameron *nec* Smith).

T. fitzgeraldi sp. n.

Female. Black, antennae with segments 1–3 entirely and 4–12 beneath, apex of clypeus, mandibles, fore legs (including coxae), mid legs except annulations of tarsi, apex of coxae, trochanters and annulations of tarsi of hind legs, tegulae, testaceous. Posterior margin of pronotal lobe and basal quarter of hind tibiae white. Wings hyaline. Pubescence silvery. Length 7 mm.

Occiput shining, finely punctured. Eyes rather closer at clypeus than on occiput where separated by a distance a little greater than length of antennal segments 3 + 4. Ocelli separated by one-quarter their diameter from eyes, by two-thirds their diameter from one another. Vertex dull, finely coriaceous, unpunctured, central impression very weak. Supraantennal keel not at all raised with a subobsolete keel. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by half their diameter. Antennae with scape nearly twice as long as its greatest width, 3 four times as long as broad (much thinner than 2), rather shorter than 4 + 5, 4 and 5 of equal length, two and a half times as long as broad, remaining segments progressively shorter till the penultimate ones are about quadrate, 12 two and a quarter times as long as broad. Clypeus evenly rounded with sparse outstanding bristles. Occipital keel complete, horizontal space behind the buccal cavity moderately broad, as wide as twice the width of the fore basitarsi. Tempora beneath shining, hardly punctured. Stipes of maxillae smooth and shining. Proepisternal keel obsolete, tubercle hardly prominent. Pronotum with the centre a little, angles not, prominent, lateral tubercles obsolete. Mesopleuron shining, almost unpunctured. Pleural suture obsolete. Mesonotum moderately shining, finely alutaceous, closely and finely punctured, scutellum flat, more shining. Metanotum flat, obsoletely punctured, lateral lobes with one stria, posterior margin narrowly hyaline, depressions deep and subcircular. Area beneath the metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal surface with area weakly defined by a U-shaped furrow, central depression broad but very weak, surface finely and rather regularly striate, striae nearly transverse (only a little bent forwards on disc). Posterior surface with a shallow furrow, well defined above, crossed by two weak keels below, ending before the orifice, no keeled depression, orifice with dorsal edge just downcurved, angles with no keels, coarsely and not closely striate. Sides shining, weakly and rather irregularly striate, well defined above. Fore coxae with no bristles at apex. Hind coxae with no ventral organ. First abdominal tergite with a short furrow, spiracular area one and a half times as long as broad, apophyses weak, tergite at base as broad as length of hind trochanter, twice as broad at apex, as long as hind femur + trochanter. Second tergite two-fifths as long as first, two and a half times as long as wide at apex. First tergite strongly, second hardly contracted at apex. Sixth tergite unkeeled. Sternites pubescent.

Male. Length 5 mm. Antennae with only 1–5 pale beneath, proportions of segments similar, 13 two and a half times as long as broad, 11 and 12 a little longer than quadrate. Seventh tergite simple.

Type. ♀, Trinidad, 24 April '33 (*D. Vesey FitzGerald*) (L.). Allotype. ♂, Trinidad 14 May '33 (*D. Vesey FitzGerald*) (L.).

T. unguicorne sp. n.

Male. Black, mandibles, margin of pronotal lobes, tegulae, postero-ventral surface of fore femora, most of fore tibiae and tarsi, anterior surface of mid femora, most of mid tibiae, small patch on anterior surface of hind femora, narrow base of hind tibiae, dirty yellow-brown. Wings hyaline, a little darker at apex. Pubescence silvery. Length 9 mm.

Occiput dull, very finely punctured. Eyes separated at clypeus by a distance only half that on occiput where they are separated by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by two-thirds their diameter from eyes, by their diameter from one another. Vertex dull, finely coriaceous, central impression weak. Supra-antennal keel strongly raised, especially anteriorly, forming a subacute longitudinal prominence. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by one-third their diameter. Antennae with scape twice as long as broad, 3 one and a third times as long as broad, shorter than 4 + 5, 4 and 5 quadrate, remaining segments dorsally all about quadrate, 4–9 keeled beneath, 10 somewhat swollen dorsally, ventrally regularly concave, produced at apex into a strong hook lying beneath 11, 11 and 12 each a little longer than 10, 13 one and a half times as long as broad, shorter than 11 + 12. Clypeus evenly rounded with centre faintly emarginate. Occipital keel complete, horizontal space behind the buccal cavity broad. Tempora beneath coriaceous. Stipes of maxillae shining, finely punctured. Proepisternal keel just indicated at sides, tubercle very prominent, produced into a large transverse lamella fringed with long hairs. Pronotum with centre and angles of collar not at all prominent, lateral tubercles obsolete. Mesopleuron dull, finely alutaceous and very finely and closely punctured. Pleural suture not developed. Mesonotum and scutellum dull, alutaceous, very finely and closely punctured, the latter flat. Metanotum nearly flat, finely punctured, lateral lobes striate, posterior margin broadly hyaline, depressions small and deep. Area beneath metapleural keel not defined. Propodeum with dorsal surface feebly defined by a U-shaped furrow, central impression very weak, whole surface with regular striae which are diagonal at base and transverse at apex. Posterior surface with a deep narrow furrow, not well defined above, becoming obsolete at nearly its own length from orifice, no keeled depression, orifice with dorsal margin sharp-edged, angles with no keels, rather finely striate. Sides dull, sharply defined above, finely and regularly striate. First abdominal tergite with a deep but short furrow, spiracular area quadrate, apophyses obsolete, tergite at base as wide as length of hind trochanter, nearly twice as wide at apex, rather longer than hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as long as apical width. First tergite little, second not contracted at apex. Seventh tergite apically truncate. Apical sternites pubescent.

Type. ♂, Bolivia (V.).

T. cornigerum Cameron (1889).

Female. Black, apex of clypeus piceous; antennal segments 1–7 beneath, mandibles, fore tibiae and tarsi, mid tibiae and annulations of mid tarsi, narrow base of hind tibiae, reddish-testaceous. Tegulae and a narrow base of abdominal tergites 2 and 3 somewhat paler. Wings hyaline. Pubescence silvery. Length 10 mm.

Occiput moderately shining, finely sculptured. Eyes much closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by half their diameter from eyes, by one and a third diameters from one another. Vertex dull, coarsely coriaceous, with a fine central impression. Supraantennal keel considerably raised in front, as long as third antennal segment. Limiting keels of antennal scrobes forming a straight transverse keel. Antennal sockets separated by less than one-quarter their diameter. Antennae with scape twice as long as greatest width, 3 nearly twice as long as broad, much shorter than 4 + 5, 4 and 5 subequal, two and a half times as long as broad, remaining segments all longer than broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus regularly rounded at apex, surface with sparse outstanding bristles. Occipital keel complete, strongly raised behind horizontal area which is unusually broad, as broad as fore tibiae. Tempora beneath shining, unpunctured. Stipes of maxillae shining, unpunctured. Proepisternal keel only visible towards centre as a slight elevation followed by a faint impression, tubercle moderately raised with a bluntly rounded point. Pronotum with centre and angles of collar strongly prominent, lateral tubercles moderately strong, sharp-edged. Mesopleuron closely and moderately strongly punctured. Pleural suture extending half-way up pleuron. Mesonotum and scutellum dull, alutaceous, closely and moderately strongly punctured, the latter flat. Metanotum flat, closely and finely punctured, lateral lobes striate, posterior margin not hyaline, depressions moderately deep. Area beneath metapleural keel defined. Metasternum with a narrow V-shaped emargination. Propodeum with dorsal surface flat, with striae starting at its mid line and diverging outwards and backwards, more transverse posteriorly. Posterior surface with a strong narrow furrow, crossed below by one fine keel, extending to orifice, no keeled depression, orifice with dorsal margin a little downcurved, angles with no keels, striate. Sides shining, finely and irregularly striate, defined above by a strong keel and furrow, with two fine keels curving up in front of hind coxae. Fore coxae with no strong bristles at apex. Hind coxae with no ventral tubercle. First abdominal tergite with no furrow, spiracular area nearly twice as long as broad, apophyses weak, tergite at base as broad as length of hind trochanter, nearly twice as broad at apex, as long as hind femur + trochanter + coxa. Second tergite three-fifths as long as first, three times as long as its apical width. First tergite rather strongly, second not contracted at apex. Sixth tergite keeled on apical half. Apical sternites pubescent.

Male. Antennae with 1–9 and basal part of 10 pale beneath; mid tibiae dorsally dark; four hind tarsi pale annulated; abdomen dark. Length 7 mm.

Ocelli separated by between one-half and two-thirds their diameter from eyes. Vertex with fine punctures on the coriaceous surface. Supraantennal keel less raised. Antennae with scape nearly twice as long as greatest width, 3 one and two-thirds times as long as broad, much shorter than 4 + 5, 4 and 5 subequal, one and a quarter times as long as broad, 6–8 rather longer, 9–12 larger, broader, quadrate, 9 and 10 with a fine keel beneath, 10 somewhat contracted at base, swollen at apex and produced under 11, 13 two and a half times longer than broad, nearly as long as 11 + 12. Seventh tergite simple.

Specimens examined: Type. ♀, Mexico, N. Yucatan (*Gaumer*) (B.C.A.); another ♀ with the same data. *Panama:* 2 ♂♂, Taboga Is., 26 and 22 Feb. '12 (*A. Busck*) (W.); 5 ♂♂, Portobello, 20 April '12 (*A. Busck*) (W.); ♀, Tabernilla, 23 July '07 (*A. Busck*) (W.). *Trinidad:* ♂ 29 April, ♀ 26 April '33 (*D. Vesey FitzGerald*). *Brazil:* ♂, Minas Geraes, near Passo Quatro, edge of R. Las Pedras, 1000 metres, '03 (*E. R. Wagner*) (P.). *Argentina:* ♀, Prov. Santiago del Estero, near Icano, edge of R. Salado, Nov. '09 (*E. R. Wagner*) (P.).

The males described above probably belong to this species, which seems to be rather a variable one. The male from Minas Geraes has the antennae entirely black. The female from Tabernilla is only 7·5 mm. long, the ocelli are separated by one-third their diameter from eyes and the dorsal area and sides of the propodeum are more obsoletely striate.

The female from the Argentine might almost form a separate subspecies if more material were available. The antennae are entirely pale beneath and the hind tibiae are more extensively pale.

T. maidli sp. n.

Female. Black, narrow apex of first four antennal segments, apex of clypeus, mandibles, palpi, posterior margin of pronotal collar, tegulae, apical third of fore femora, fore tibiae and tarsi, mid femora and tibiae, apex of hind femora, basal quarter of hind tibiae, annulations of hind tarsi, pale yellow-brown. Margin of pronotal tubercles, base and apex of mid basitarsus and annulations of other mid tarsal segments, whitish. Wings hyaline. Pubescence silvery. Length 9–10 mm.

Occiput moderately shining, hardly sculptured. Eyes separated at clypeus by two-thirds what they are on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by half their diameter from eyes, by three-quarter diameters from one another. Vertex dull, finely coriaceous, with numerous obsolescent punctures, no central impression. Supraantennal keel moderately raised, with fine keel, bifurcating posteriorly, as long as scape of antennae. Limiting keels of antennal scrobes forming a straight transverse keel. Antennal sockets almost contiguous. Antennae with scape a little longer than twice greatest width, 3 three and a half times as long as broad, shorter than 4 + 5, 4 and 5 subequal, two and a half times as long as broad, remaining segments progressively shorter, penultimate ones about quadrate, 12 twice as long as broad, a little shorter than 10 + 11. Clypeus with apical margin rounded, surface with sparse outstanding bristles. Occipital keel very strong, complete, horizontal space behind buccal cavity unusually broad, as broad as length of antennal segment 4. Tempora beneath smooth, unsculptured. Stipes of maxillae smooth, unsculptured. Proepisternal keel obsolete, but tubercle rather prominent owing to a diagonal transverse impression just in front of it. Pronotum with centre very slightly and angles of collar distinctly prominent, lateral tubercles obsolete. Mesopleuron moderately shining, weakly alutaceous, finely and not very closely punctured. Pleural suture just indicated ventrally. Mesonotum and scutellum dull, strongly alutaceous, finely and closely punctured, the latter flat, weakly longitudinally impressed. Metanotum deeply impressed, finely punctured, lateral lobes striate, posterior margin hyaline, depressions pyriform, deep. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal area well defined by a U-shaped furrow, central impression hardly perceptible, shining, with not very regular striae which are diagonal at base and more transverse at apex. Posterior surface with a shallow furrow, sharply defined above, below crossed by two fine keels, ending at half its length from orifice, keeled depression obsolete, but with a small longitudinal keel, orifice with dorsal margin hardly downcurved, angles with distinct keels, shining, weakly rugose and sparsely striate. Sides very shining, obsoletely striate, well defined above, with a fine keel curving up from in front of hind coxae. Fore coxae with no strong bristles. Hind coxae with no ventral tubercle. First abdominal tergite with a short furrow, spiracular area one and a third times longer than broad, apophyses distinct, rounded, tergite parallel-sided for nearly the basal half of its length, at base as wide as length of hind trochanter, twice as wide at apex, as long as hind femur + trochanter + coxa. Second tergite a little longer than half first, three times as long as apical width. First tergite moderately, second not contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Type. ♀, Brazil, Para, 16 Aug. '99 (*Ducke*) (V.). Paratype. ♀, Brazil, Para, 9 Sept. '99 (*Ducke*) (V.). *T. parvum* Schrottky (1902, p. 114), Buenos Aires, may be an earlier name for this species.

var. **bodkini** var. n.

Similar but sides of propodeum with weaker striae, even in the neighbourhood of keel in front of hind coxae none is strong. Fore femora largely black, mid femora dark ventrally.

Male. Length 7 mm. Eyes above separated by a distance equal to a little more than length of antennal segments 3 + 4. Ocelli separated by two-thirds their diameter from eyes, by their diameter from one another. Antennae with scape one and a half times as long as its greatest width, 3 three and a half times as long as broad, shorter than 4 + 5, 4 and 5 subequal, twice as long as broad, remaining segments progressively shorter, penultimate segments quadrate, 13 one and a half times as long as broad. Clypeus more truncate, no outstanding bristles. Proepisternal tubercle more prominent, bearing a tuft of white pubescence. Posterior furrow of propodeum crossed by a single strong keel. Seventh tergite simple.

Type. ♀, British Guiana, N.W. District, Sept. '13 (*G. F. Bodkin*) (L.). Allotype ♂ and paratype ♀, Trinidad, 20 April '33 (*D. Vesey FitzGerald*).

T. scutiferum Taschenberg (1875).

Female. Black, scape of antennae and underside of segments 2–3, apex of clypeus, mandibles, pronotal tubercles, tegulae, posterior lobes of the mesosternum, fore legs except the coxae, trochanters and a faint cloud on dorsal surface of base of femora, mid legs except coxae and trochanters, narrow base of hind tibiae, annulations of hind tarsi, apex of abdominal tergites 3–4 indeterminately, testaceous. Wings hyaline. Pubescence silvery. Length 7·5 mm.

Occiput moderately shining. Eyes separated at clypeus by half as much as on occiput where separated by the length of antennal segments 2 + 3 + 4. Ocelli separated by three-quarters their diameter from eyes, by one and a half diameters from one another. Vertex dull, coriaceous, with traces of fine, rather close punctures, central impression moderately strong. Supraantennal keel rather distinctly raised, as long as segment 3 of antennae. Limiting keels of antennal scrobes forming a nearly straight (weakly bisinuate) transverse keel, emitting a small one between the sockets. Antennal sockets separated by half their diameter. Antennae with scape twice as long as greatest width, 3 shorter than scape, one and three-quarter times as long as broad, much shorter than 4 + 5, 4 and 5 equal in length, one and a half times as long as broad, remaining segments about as long as 5, but 11 is quadrate, 12 twice as long as broad, nearly as long as 10 + 11. Clypeus (apex broken), surface with sparse outstanding bristles. Occipital keel complete, horizontal space behind the buccal cavity very broad, at least as broad as greatest width of fore tibiae. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel extending sharp-edged from sides to half-way to centre, tubercle prominent. Pronotum with centre and angles of collar not prominent, lateral tubercles moderately strong, but rounded. Mesopleuron moderately shining, closely and finely punctured. Pleural suture obsolete. Mesonotum dull, alutaceous, closely and finely punctured. Scutellum shining, closely and finely punctured, flat. Metanotum flat, finely punctured, lateral lobes with one strong stria, posterior margin hyaline, depressions deep and circular. Propodeum with dorsal surface shining, well defined, with a weak central impression, and strong striae which are diagonal at base and transverse at apex. Posterior surface with a rather broad and shallow furrow, well defined above, ending in a weak keeled depression which is divided by a longitudinal stria, orifice with dorsal margin a little downcurved, angles with no keels, with rather strong and regular striae. Sides moderately shining, finely and regularly striate, well defined above, with a fine keel curving up in front of hind coxae. Fore coxae with no strong bristles at apex. Hind coxae with a weak ventral tubercle on inner side just before apex. First abdominal tergite with a short furrow, spiracular area quadrate, apophyses nearly obsolete, tergite at base narrower than length of hind trochanter, twice as broad at apex, nearly as long as hind femur + trochanter. Second tergite two-thirds as long as first, twice as long as apical width. First and second tergites very little contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Specimens examined: Type. ♀, Brazil (H.).

T. frioense sp. n.

Female. Black, antennae beneath and apices of basal segments more or less red tinged. Narrow apex of clypeus, mandibles, tegulae, apex of fore femora, fore tibiae and tarsi, mid legs beyond the trochanter, base and very narrow apex of hind tibiae, yellow-brown. Wings hyaline. Pubescence silvery. Length 8 mm.

Occiput dull, finely sculptured. Eyes much closer at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by half their diameter from eyes, by three-quarter diameters from each other. Vertex dull, finely coriaceous with a weak central impression. Supraantennal keel somewhat prominent with a fine keel. Limiting keels of antennal scrobes forming a straight transverse keel. Antennal sockets contiguous. Antennae with scape one and a half times as long as greatest width, 3 three times as long as broad, not as long as 4 + 5, 4 and 5 subequal, twice as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad, shorter than 10 + 11. Clypeus with apical margin rounded, surface with no outstanding bristles. Occipital keel complete, horizontal space behind buccal cavity narrow. Tempora beneath very finely and moderately closely punctured. Stipes of maxillae smooth and shining. Proepisternal keel obsolete, tubercle rather strongly prominent. Pronotum with centre and angles of collar rather prominent, lateral tubercles weak and rounded. Mesopleuron moderately shining, rather closely and strongly punctured. Pleural suture obsolete. Mesonotum dull, alutaceous, rather closely and strongly punctured, scutellum rather less closely punctured, convex. Metanotum impressed in centre, lateral lobes unusually large, posterior margin not hyaline, depressions shallow. Area beneath metapleural keel defined. Propodeum rather clearly defined by a U-shaped furrow, no central impression, surface crossed by irregular striae which are diagonal at base and more transverse at apex. Posterior surface with a deep narrow furrow broadening below crossed by one keel, keeled depression ill-defined, bisected by a longitudinal keel, each half longer than broad, orifice with dorsal margin a little downcurved, angles with no keels, clathrately rugose. Sides shining, unsculptured, well defined above. Fore coxae with no strong bristles at apex. Hind coxae with no ventral tubercle. First abdominal tergite with a furrow for a quarter of its length, spiracular area one and a half times as long as broad, apophyses weak, tergite at base as broad as length of hind trochanter, one and two-thirds times as broad at apex as long as hind femur + trochanter + coxa. Second tergite a little more than half as long as first, two and two-thirds times as long as broad at apex. First tergite slightly, second not contracted at apex. Sixth tergite nearly twice as long as broad at base, unkeeled. Apical sternites pubescent.

Male. Length 7·5 mm. Ocelli separated by nearly their diameter from eyes, by one and a half diameters from one another. Antennae with 10–12 quadrate, 13 nearly twice as long as broad, shorter than 11 + 12. Striae of dorsal surface of propodeum more regular, of angles more irregular. Keeled depression obsolete, with no longitudinal keel. Sternites

2–4 nearly hidden basally by the strongly deflexed tergites, only an apical triangular area exposed.

Type. ♂, Colombia, Rio Frio, Magdalena, 15 July '27, nest no. 348 (*Salt*).
Allotype. ♀, the same locality, 20 Nov. '26, nest no. 310 (*Salt*).

T. asuncicola Strand (1910).

Female. Black, apex of clypeus, mandibles, posterior margin of pronotal tubercles, tegulae, apex of all coxae, narrow base and apex of femora, fore and mid tibiae, basal quarter of hind tibiae, narrow apical annulation of all basitarsi, pale yellowish-brown. Sides of tergites 1–4 testaceous tinged. Wings hyaline. Pubescence silvery. Length 7·5 mm.

Occiput smooth and shining. Eyes separated by only three-quarters the distance at clypeus that they are on occiput, where distance nearly equals the length of antennal segments 3 + 4 + 5. Ocelli separated by their diameter from eyes, by a little more from one another. Vertex dull, finely coriaceous, central impression obsolete. Supraantennal keel obsolete. Limiting keels of antennal scrobes forming a straight transverse keel immediately above the sockets between which it does not emit a keel. Antennal sockets separated by half their diameter. Antennae with scape hardly one and a half times as long as broad, 3 three times as long as broad, much shorter than 4 + 5, 4 and 5 subequal about twice as long as broad, remaining segments all a little longer than broad, 12 about two and a half times as long as broad, one and a half times as long as 11. Clypeus with a shallow, moderately broad emargination, surface with dense outstanding hairs. Occipital keels nearly complete and also nearly meeting keel defining buccal cavity, behind which there is almost no horizontal space. Tempora beneath shining, unpunctured. Stipes of maxillae shining, unpunctured. Proepisternal keel obsolete. Pronotum with centre and angles of the collar not prominent, lateral tubercle weak and rounded. Mesopleuron shining, closely and finely punctured. Pleural suture obsolete. Mesonotum and scutellum somewhat dull, slightly alutaceous, finely and very closely punctured, the latter flat. Area beneath metapleural keel defined. Metanotum a little depressed in centre, lateral lobes striate, posterior margin narrowly hyaline, depressions deep. Metasternum not emarginate. Propodeum with dorsal surface defined by a very weak U-shaped furrow, a shallow, central, longitudinal depression, surface with fine, moderately regular striae which are diagonal at base and more transverse at apex. Posterior surface with a deep narrow furrow, well defined above, ending near orifice, no keeled depression, dorsal margin of orifice a very little downcurved, angles without keels, finely rugose. Sides shining, rather obsoletely striate, defined above by a weak keel. Fore coxae with dense pubescence but with no strong apical bristles. Hind coxae with no ventral tubercle. First abdominal tergite with a furrow extending as far as spiracles, spiracular area one and a half times as long as broad, apophyses weak, tergite at base as broad as length of hind trochanter, twice as broad at apex, nearly as long as hind femur + trochanter + coxa. Second tergite a little longer than half the first, two and a quarter times as long as broad at apex. First tergite moderately, second not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Male. Fore tarsi entirely pale. Antennae with scape narrow basally, suddenly broadening at middle, about twice as long as broad in middle, 2 unusually large, quadrate, 3 somewhat shorter than 4 + 5, 4 a little longer than 5, about one and a half times as long as broad, 9–12 quadrate and somewhat moniliform, 13 a little longer than broad. Apical margin of clypeus somewhat truncate. Dorsal area of propodeum with almost no central depression. Second abdominal tergite almost three times as long as broad at apex. Last tergite simple.

Specimens examined: Type. ♀, Paraguay, Asuncion, Aug. '05 (*J. D. Anisits*) (B.). Allotype. ♂, Paraguay, Asuncion, 3 July '05 (B.). *Paraguay:*

♀, San Bernardino (*Fiebrig*) (V.). *Argentina:* 2 ♀♀, Prov. Santiago del Estero, edge of R. Salado, near Icano, Mistol Paso, Jan. '09 (*E. R. Wagner*) (P.); 5 ♂♂, 1 ♀, Buenos Aires, '63 (*Duhamel*) (P.); ♀, Buenos Aires (B.). The last named specimen is somewhat aberrant. The dorsal surface of the propodeum has fewer and more irregular striae and is granulate outside the area. The sides are alutaceous and only striate on the lower third.

var. **levius** var. n.

Female. Black, narrow apex of first two antennal segments, apex of clypeus, mandibles, pronotal tubercles and narrow margin of pronotal collar, narrow apex of all trochanters and base of all femora, apex of four hind femora, fore tibiae and tarsi, mid tibiae and annulations of mid tarsi, basal quarter of hind tibiae and sides and narrow base of abdominal tergites 2–3, yellowish-brown. Length 6·5 mm.

Mesonotum shining, not alutaceous. Propodeum with dorsal area with less numerous and more irregular transverse keels. Sides smooth and shining.

Type. ♀, Brazil, Rio de Janeiro, 6 Feb. '94 (V.). Paratypes. *Brazil:* ♀, Mt. des Orgues, Prov. Rio de Janeiro, Massif Tijuca, '02 (*E. R. Wagner*) (P.) (note on specimen—very narrow cells in nest); ♀, Bahia, 19 Aug. '83 (W.). The last mentioned specimen has the apex of all coxae and the underside of the fore femora pale. The dorsal area of propodeum is duller and has more numerous striae.

It is possible that this form may be found to be the representative of the species in the rain-forest area; alternatively more material might supply an even more complete transition to the nominal form.

T. pachygaster sp. n.

Male. Black, antennae with segment 11 and segments 1–2 and 12–13 beneath, apex of clypeus, mandibles except tip, fore legs except base of coxae and dorsal and ventral streaks on femora, mid legs except base of coxae, streaks on femora and apical annulations of tarsal segments 1–4, hind legs with apex of coxa, trochanter, basal third of tibia and annulations of tarsi, posterior lobes of mesosternum, posterior margin of pronotal lobes, tegulae, whitish-testaceous. Wings hyaline. Pubescence silvery. Length 10 mm.

Occiput shining, finely sculptured. Eyes much closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by half their diameter from eyes, by two-thirds their diameter from one another. Vertex dull, densely alutaceous, with rather close, fine, flat-bottomed punctures, central impression very weak. Supraantennal keel little raised with an obtuse keel three-quarters the length of the antennal scape. Limiting keels of antennal scrobes practically obsolete, angulated. Antennal sockets separated by half their diameter. Antennae with scape twice as long as its greatest width, 2 ellipsoidal, one and a half times as long as broad, 3 two and a half times as long as broad, as long as 4, 5 a little shorter than 4, 6 similar, 7 quadrate, 8 just transverse, 9 quadrate, 10 transverse, thickened beneath and produced beneath 11, 11–12 quadrate, 13 two and a half times as long as broad, almost as long as 9 + 10 + 11 + 12; 4 a little emarginate beneath, 5 strongly emarginate beneath and keeled, 6 even more emarginate beneath, keeled, apex produced beneath 7 into a subacute prominence, 7 keeled beneath, 9 keeled and a little emarginate beneath. Clypeus truncate at apex with central third weakly and roundly produced. Occipital keel incomplete, horizontal space behind buccal cavity rather narrow. Tempora beneath moderately shining, very closely and obsoletely punctured. Stipes of maxillae smooth and shining. Proepisternal keel obsolete, tubercle strongly prominent, weakly lamellate at apex, bearing a tuft of pubescence. Pronotum with centre and angles not prominent, lateral tubercles obsolete. Mesopleuron shining, finely and rather closely punctured. Pleural suture obsolete. Mesonotum and scutellum rather dull, finely alutaceous, closely and finely punctured, the latter flat. Metanotum flat, closely and finely punctured, lateral lobes invisible. Area beneath the metapleural keel not defined. Metasternum with a very narrow emargination. Propodeum with dorsal surface flat, area not defined, central impression weak, surface with fine striae which are diagonal at base and more transverse at apex and traces of subobsolete punctures. Posterior surface with a strong, narrow furrow, well defined above, ending half its length from orifice of which the dorsal edge is a little downcurved, no keeled depression, angles with no keels, shining with obsolete striae. Sides shining and smooth, sharply defined above anteriorly. Fore coxae ventrally somewhat flattened and impressed. All legs rather thick, with femora, especially the fore femora, swollen. First abdominal tergite with a short furrow, spiracular area quadrate, apophyses obsolete, tergite at base as broad as length of hind trochanter, two and a half times as wide at apex, as long as hind femur + trochanter. Second tergite three-fifths as long as first, as long as broad at apex. First and second tergites hardly contracted at apex. Seventh tergite simple. Sternites pubescent. Abdomen unusually stout.

Type. ♂, Trinidad, 7 June '33 (*D. Vesey FitzGerald*) (L.).

T. posterorubrum sp. n.

Female. Black, scape of antennae beneath, base of mandibles, palpi, posterior margin of both pronotal collar and tubercles, tegulae, fore tibiae except dorsal streak, fore tarsi, narrow base mid tibiae, basal half mid basitarsus, same parts in hind legs, posterior lobes of mesosternum, whitish-yellow. Abdomen with first segment black with sides red, remainder dark red. Wings subhyaline. Pubescence silvery. Length 14 mm.

Occiput moderately shining, obsoletely punctured. Eyes a little closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by half their diameter from eyes, by three-quarters their diameter from each other. Vertex rather strongly raised, moderately shining, finely alutaceous, with large deep punctures separated by about their diameter, central impression distinct. Supraantennal keel considerably raised bearing a strong keel, at anterior end of which, just behind limiting keels, vertex is depressed. Limiting keels of antennal scrobes forming a strongly raised angulated, transverse keel emitting a strong one between the sockets. Antennal sockets separated by their diameter, their edges a little raised. Antennae with scape twice as long as greatest width, 3 three times as long as broad, much shorter than 4 + 5, 4 hardly longer than 5 which is two and a quarter times as long as broad, 6–11 all about twice as long as broad, 12 a little longer. Clypeus with apex evenly rounded, surface with sparse outstanding hairs. Occipital keel incomplete, horizontal space behind the buccal cavity moderately broad. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel just indicated, tubercle not prominent. Pronotum with centre and angles of collar not prominent, lateral tubercles weak. Mesopleuron shining, very finely and sparsely punctured. Pleural suture obsolete. Mesonotum shining with some moderately strong punctures on disc anteriorly. Scutellum smooth and shining, flat. Metanotum nearly flat, smooth and shining, lateral lobes striate, posterior margin narrowly hyaline, depressions deep. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal area rather well defined by a U-shaped furrow, smooth and shining, central longitudinal impression distinct, a few diagonal striae at base and a few weak transverse ones at apex. Posterior surface with a shallow furrow, well defined above, shallowing out before the orifice, no keeled depression, orifice with dorsal margin a little downcurved, angles with no keels, subrugose becoming coarsely striate above. Sides well defined above, smooth and shining with a fine keel curving up in front of hind coxae. Fore coxae with no bristles at apex. Hind coxae with no ventral tubercle. First abdominal tergite with a furrow for half its length, spiracular area quadrate, apophyses obsolete, tergite at base as broad as length of hind trochanter, twice as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, twice as long as apical width. First tergite rather strongly, second hardly at all contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Type. ♀, Mexico, Orizaba, '62 (*Biart*) (P.).

T. crudele sp. n.

Female. Black, antennae with segments 1–2, especially beneath, 3–4 tinged beneath, mandibles, palpi, tegulae, pronotal tubercles and collar posteriorly, fore legs except most of coxae and dorsal streak on femora, four hind legs with trochanters, narrow apex of femora, apex of tibiae, base of basitarsus, annulations of tarsi, whitish-testaceous; abdomen with base, sides and narrow apex of tergite 2, narrow apex of 3 and base of 4, sternites 2–4, testaceous tinged. Wings hyaline, a little darker at apex. Pubescence silvery. Length 9·5 mm.

Occiput shining, almost unsculptured. Eyes almost twice as close together at clypeus as on occiput, where separated by a distance rather greater than length of antennal segments 3 + 4. Ocelli separated by rather less than half their diameter from eyes, by their diameter from one another. Vertex dull, coriaceous with a weak central impression. Supra-antennal keel not on a prominence, very short. Limiting keels of antennal scrobes forming an angulated transverse keel emitting a fine keel between the sockets. Antennal sockets separated by one-third their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 three and a half times as long as broad, much shorter than 4 + 5, 4 a little longer than 5 which is two and a quarter times longer than broad, remaining segments progressively shorter, 10–11 quadrate, 12 about twice as long as broad, as long as 10 + 11. Clypeus with the apical margin a little produced and upturned, surface with sparse outstanding bristles. Occipital keel complete, horizontal space behind buccal cavity moderately broad, one and a half times as broad as width of fore basitarsus. Tempora beneath smooth and shining. Stipes of maxillae dull, alutaceous. Proepisternal keel faintly indicated at sides, tubercle not prominent. Pronotum with centre and angles of collar not prominent, lateral tubercles weak and rounded. Mesopleuron shining, closely and finely punctured. Pleural suture obsolete. Mesonotum and scutellum dull, closely and finely punctured, the latter moderately convex. Metanotum moderately convex, finely punctured, lateral lobes with posterior margin not hyaline, depressions deep. Area beneath metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal surface flat with a very weak central longitudinal impression, with numerous weak striae, diagonal at base and transverse at apex, surface moderately shining. Posterior surface with a deep narrow furrow, well defined above, ending below in three rather closely approximated keels the most ventral of which is the bifurcating top of keel which longitudinally bisects the keeled depression, each half of which is quadrate, orifice with its dorsal margin very slightly downcurved, angles with weak keels, with regular, rather widely spaced striae. Sides shining, unsculptured, well defined above, with a fine straight keel extending up from in front of hind coxae. Fore coxae with no strong bristles at apex. Hind coxae with a very small, perforated, ventral tubercle just before apex. First abdominal tergite with no furrow, spiracular area quadrate, apophyses obsolete, tergite at base as broad as length of hind trochanters, twice as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, two and a third times as long as broad at apex. First moderately, second hardly contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Type. ♀, Panama, Tabogilla Is., 18 Feb. '12 (*A. Busck*) (W.).

T. xenophon sp. n.

Female. Black, base of scape of antennae, apex of clypeus, mandibles, tegulae, narrow base of tibiae, narrow base and sides of abdominal tergites 2–4, reddish-testaceous. Fore tarsi and base of each of four hind basitarsi whitish. Wings hyaline. Pubescence silvery. Length 10 mm.

Occiput dull, finely and closely punctured. Eyes much closer at clypeus than on occiput where separated by a distance equal to length of antennal segment 3 + half 2. Ocelli separated by one-quarter their diameter from eyes, by two-thirds their diameter from one another. Vertex rather dull, finely alutaceous and obsoletely and not very closely punctured, punctures moderately large, central impression distinct anteriorly. Supraantennal keel strongly raised bearing a fine keel as long as antennal segment 3. Limiting keels of antennal scrobes forming an angulated transverse keel emitting a small one between the sockets. Antennal sockets separated by hardly more than one-third their diameter. Antennae with scape twice as long as greatest width, 3 four times as long as broad, much shorter than 4 + 5, 4 a little longer than 5 which is two and a half times longer than broad, 6–11 all longer than broad, 12 two and a half times longer than broad, shorter than 10 + 11. Clypeus with centre of apical margin produced into a small lobe which is weakly emarginate, surface with sparse outstanding bristles. Occipital keel not quite complete, horizontal space behind the buccal cavity moderately broad, about as broad as width of fore basitarsus. Tempora beneath shining, sparsely and finely punctured. Stipes of maxillae, alutaceous, moderately shining. Proepisternal keel just indicated at sides, tubercle rather prominent. Pronotum with centre of collar a little prominent, angles distinctly so, lateral tubercles distinct though rounded. Mesopleuron moderately shining, finely alutaceous, closely and rather finely punctured. Pleural suture obsolete. Mesonotum and scutellum shining, very finely alutaceous, closely and rather finely punctured. Metanotum nearly flat, very finely punctured, lateral lobes with two striae, posterior margin broadly hyaline, depressions deep, pyriform. Area beneath metapleural keel defined. Metasternum with a small emargination. Propodeum with dorsal surface moderately well defined by a U-shaped furrow, with a weak central depression, with fine regular striae which are diagonal at base and transverse at apex. Posterior surface with a deep, narrow furrow, well defined above, crossed by two weak striae below where it becomes shallower, a distinct keeled depression bisected by a fine longitudinal keel, orifice with dorsal margin considerably downcurved, angles with no keels, shining, finely striate. Sides smooth and shining, well defined above, with a fine keel curving up in front of hind coxae. Fore coxae with only a few weak bristles at apex. Hind coxae with a very small ventral tubercle on inner edge near apex. First abdominal tergite with a short furrow, spiracular area one and a half times longer than broad, apophyses very weak, tergite at base as wide as length of hind trochanter, two and a half times as wide at apex, a little longer than hind femur + trochanter. Second tergite half the length of first, twice as long as apical width. Sixth tergite with a keel on apical half. Apical sternites pubescent.

Type. ♀, Panama, Portobello, 13 March '11 (*A. Busck*) (W.).

T. trinidadense sp. n.

Female. Black, antennae with the scape indeterminately beneath, apex of scape and segment 2, apex of clypeus, mandibles, margin of pronotal tubercles, tegulae, fore femora except base posteriorly, fore tibiae and tarsi, mid femora except base ventrally, mid tibiae except dorsal streak, narrow base of hind tibiae, a complete ring at base of third abdominal segment, reddish-testaceous. Four hind tarsi white annulated. Wings hyaline. Pubescence silvery. Length 9 mm.

Occiput smooth and shining. Eyes separated at clypeus by two-thirds the distance that they are on occiput where they are separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by less than one-quarter their diameter from eyes, by three-quarters their diameter from one another. Vertex dull, finely alutaceous, with sparse, very shallow punctures, central impression feeble, vertex on each side of it a little raised. Supraantennal keel little raised, bearing a very short, fine keel. Limiting keels of antennal scrobes forming a weak, angulated transverse keel emitting a fine one between the sockets. Antennal sockets separated by two-thirds their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 three and a half times as long as broad, much shorter than 4 + 5, 4 hardly longer than 5 which is two and a half times as long as broad, remaining segments progressively shorter but all longer than broad, 12 two and a half times as long as broad, shorter than 10 + 11. Clypeus with apical margin produced into a small central lobe which is a little emarginate and with a small emargination on each side of lobe, surface with very sparse outstanding hairs. Occipital keel complete, horizontal space moderately broad, a little wider than breadth of fore basitarsus. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel just indicated laterally, tubercle not prominent. Pronotum with centre and angles of collar a little prominent, lateral tubercles obsolete. Mesopleuron moderately shining, finely and closely punctured. Pleural suture not developed. Mesonotum moderately shining, closely and finely punctured. Scutellum shining, sparsely punctured, flat. Metanotum flat, finely punctured, lateral lobes with posterior margin broadly hyaline, depressions shallow. Area beneath metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal area practically not defined, central depression broad and feebly defined, smooth and shining, whole surface with fine striae which are mainly transverse but more diagonal at base. Posterior surface with a rather deep narrow furrow, well defined above, almost extending to orifice, crossed below by two or three weak striae, keeled depression hardly indicated, orifice with dorsal margin just downcurved, angles with no keels, smooth and shining, laterally finely striate. Sides smooth and shining, weakly defined above. Fore coxae with no strong bristles at apex. Hind coxae with a small, perforated, ventral tubercle on inner margin near apex. First abdominal tergite with a very short furrow, spiracular area a little longer than broad, apophyses very weak, tergite at base as wide as length of hind trochanter, two and a half times as wide at apex, a little longer than hind femur + trochanter. Second tergite two-thirds as long as first, one and two-thirds times as long as apical width. First tergite moderately, second hardly contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Type. ♀, B.W.I., Trinidad, 7 miles N.W. of Moruga Village, 13 April '25 (*P. Andrews*) (W.). Paratype. ♀, Paraguay, San Bernardino (*K. Fiebrig*) (B.). In the paratype the apical margin of the clypeus is not emarginate, only produced over the central third; the supraantennal keel, also, is more prominent.

T. johnsoni Fox (1891).

Female. Black, antennae with segments 1–2 beneath, apex of clypeus, mandibles, palpi, four front legs except coxae, apex of hind coxae, narrow apex of hind femora, basal third of hind tibiae, basal half of all segments of hind tarsi, posterior lobes of mesosternum, reddish-yellow. Sides of first abdominal tergite, narrow basal band and sides of second and third, sternites 2–3 except apex, reddish-testaceous. Wings hyaline. Pubescence silvery. Length 8·5 mm.

Occiput moderately shining, closely and finely punctured. Eyes distinctly closer together at clypeus than on occiput where separated by a distance equal to length of segments 2 + 3 of antennae. Ocelli separated by one-third their diameter from eyes, by one diameter from one another. Vertex dull, densely alutaceous, finely and rather sparsely punctured with a faint central impression. Supraantennal keel moderately raised with a fine keel. Limiting keels of antennal scrobes forming an obtusely angulated transverse keel which emits a fine keel between the sockets. Antennal sockets separated by two-thirds their diameter. Antennae with scape twice as long as greatest width, 3 three and a half times as long as broad, only a little longer than 4, 4 distinctly longer than 5, which is two and a half times longer than broad, remaining segments all longer than broad, 12 two and a half times longer than broad, shorter than 10 + 11. Clypeus with apical margin slightly produced over median quarter, production shallowly emarginate, surface with moderately dense outstanding hairs. Occipital keel complete, horizontal space behind the buccal cavity as broad as basal width of third antennal segment. Tempora beneath shining, unsculptured. Stipes of maxillae shining, weakly alutaceous. Proepisternal keel obsolete, tubercle not very prominent. Pronotum with centre of collar hardly, angles not prominent, lateral tubercle weak and rounded. Mesopleuron shining, weakly alutaceous, finely and moderately closely punctured. Pleural suture obsolete. Mesonotum dull, finely and densely punctured, alutaceous, scutellum similar but more sparsely punctured, flat. Metanotum flat, finely punctured and alutaceous, lateral lobes striate, posterior margin hyaline, depressions large and deep. Area beneath metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal surface very imperfectly defined by a weak U-shaped furrow, with a weak central longitudinal impression, shining, with strong striae which are longitudinal at extreme base and transverse elsewhere. Posterior surface with a deep narrow furrow, well defined above, extending below to orifice, no keeled depression, orifice with dorsal margin a little downcurved, angles with no keels, finely and rather regularly striate. Sides shining, with some very obsolescent striae, posteriorly and dorsally well defined above, with a fine keel curving up from in front of hind coxae, behind this keel rugose. Fore coxae with no strong bristles at apex. Hind coxae with a small, subapical, ventral tubercle. First abdominal tergite with a short furrow, spiracular area quadrate, apophyses obsolete, tergite at base as wide as length of hind trochanter, twice as wide at apex, a little longer than hind femur + trochanter. Second tergite half the length of first, one and a third times as long as apical width. First tergite strongly, second weakly contracted at apex. Sixth tergite unkeeled, much more strongly and densely punctured than the penultimate. Apical sternite pubescent.

Specimens examined: ♀, U.S.A., Virginia, Falls Ch., 19 July '23 (*R. A. Cushman*) (det. Rohwer) (W.).

T. florale sp. n.

Female. Black, mandibles, narrow apex of clypeus, tegulae, fore tibiae except dorsal mark, and base of four hind tibiae narrowly, testaceous. Apices of abdominal tergites somewhat testaceous tinged. Wings pale fuscous. Pubescence silvery. Length 9 mm.

Occiput finely coriaceous, dull. Eyes separated at clypeus by hardly more than half what they are on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by three-quarters their diameter from eyes, by one and a half diameters from one another. Vertex dull, densely coriaceous with moderately close and large, very shallow punctures, central impression weak. Supraantennal keel fine but distinct, scarcely truncate behind. Limiting keels of antennal scrobes forming an obtusely angulated transverse keel emitting a fine one between the sockets. Antennal sockets separated by half their diameter. Antennae with scape twice as long as greatest width, 3 hardly longer, three times as long as broad, much shorter than 4 + 5, 4 hardly longer than 5, about twice as long as broad, apical segments missing. Clypeus with apical margin rounded, slightly more produced in centre, surface with sparse outstanding bristles. Occipital keel not quite complete, horizontal space behind buccal cavity moderately broad, about as broad as width of antennae. Tempora beneath very finely and rather closely punctured. Stipes of maxillae smooth and shining. Proepisternal keel obsolete. Pronotum with centre and angles of collar not prominent, lateral tubercles obsolete. Mesopleuron moderately shining, finely and rather closely punctured. Mesopleural suture obsolete. Mesonotum densely alutaceous, dull, finely and closely punctured, scutellum similar but less closely punctured, flat. Metanotum nearly flat, lateral lobes with posterior margin narrowly hyaline, depressions large and deep. Propodeum well defined by a U-shaped furrow, with a distinct longitudinal impression, regularly striate, striae diagonal at base and transverse at apex. Posterior surface with a rather shallow furrow, well defined above, separated from orifice by about a third of its length, keeled depression rather clearly defined, orifice with dorsal margin rather strongly downcurved, angles without keels, regularly striate. Sides moderately shining, finely and regularly striate, strongly defined above. First abdominal tergite with no furrow, spiracular area quadrate, apophyses obsolete, tergite at base as broad as length of hind trochanter, one and two-thirds times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, nearly twice as long as broad. First tergite moderately, second hardly contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Type. ♀, Brazil, Blumenau, Jan. '85 (*Hetschko*) (V.). The specimen is gummed on to a card so that some of the characters of the ventral surface are hidden.

T. dyeri sp. n.

Male. Black, narrow apex and underside of antennal segments 1–2, narrow apex of clypeus, mandibles, palpi, pronotal tubercles, tegulae, most of fore legs from trochanters outwards, mid tibiae, annulations of hind tarsi, narrow apex of abdominal tergites 2–4 indeterminately, testaceous. Broad annulations of mid tarsi and narrow base of hind tibiae white. Wings hyaline. Pubescence silvery. Length 6 mm.

Occiput shining, almost unsculptured. Eyes separated at clypeus by two-thirds what they are on occiput where separated by a distance equal to the length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by three-quarters their diameter from eyes, by one and a half diameters from one another. Vertex dull, densely alutaceous, with fine, shallow very close punctures, central impression very weak, median ocellus in a slight depression. Supraantennal keel not on a prominence, fine, as long as width of scape. Limiting keels of antennal scrobes weak, forming an obtusely angulated transverse keel. Antennal sockets separated by half their diameter. Antennae with scape not quite twice as long as greatest width, 3 one and two-thirds times as long as broad, much shorter than 4 + 5, 4 and 5 subequal, a little longer than broad, 7–11 quadrate, 11–12 transverse, 6 longer ventrally than dorsally, emarginate, thickened at apex and produced under 7, 9 emarginate beneath, 10 emarginate beneath at base and beyond this thickened, 9 and 10 with a fine ventral keel, 13 thick, two and a half times as long as broad, fully as long as 10 + 11 + 12. Clypeus with apical margin weakly bisinuate. Occipital keel just complete, horizontal space behind buccal cavity wide, as wide as fore tibiae at apex. Tempora beneath shining, unsculptured. Stipes of maxillae shining, unsculptured. Proepisternal keel just indicated laterally, tubercle a little prominent. Pronotum with centre and angles of collar not prominent, lateral tubercles obsolete. Mesopleuron shining, finely, closely and subgranulately punctured. Pleural suture obsolete. Mesonotum and scutellum rather dull, finely and closely punctured, mesonotum obsoletely alutaceous, scutellum flat. Metanotum moderately flat, finely punctured, lateral lobes striate, very narrow posterior margin hyaline, depressions rather shallow. Area beneath metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal surface flat with a weak longitudinal impression with fine striae which are diagonal at base and transverse at apex. Posterior surface with a rather deep narrow furrow, well defined above, extending to the keeled depression which is defined above only by the arms of a longitudinal keel which bisects it, each half of the keeled depression a little higher than broad, orifice with the dorsal margin a little downcurved, angles with short keels, finely striate, not very shining. Sides shining, obsoletely striate, especially postero-dorsally, well defined above, with traces of a keel curving up in front of hind coxae. First abdominal tergite with a furrow for half its length, spiracular area quadrate, apophyses obsolete, tergite at base as broad as length of hind trochanter, one and two-thirds times as broad at apex, as long as hind femur + trochanter. Second tergite a little longer than half first, one and a half times as long as broad at apex. First and second tergites little contracted at apex. Seventh tergite simple. Sternites almost completely hidden by the strongly deflexed tergites, only a small apical triangle exposed, all pubescent except first.

Type. ♂, Honduras, La Ceiba, 18 Sept. '16, no. 13850–13894 (*F. J. Dyer*) (W.).

T. mutilatum sp. n.

This species is represented by a single specimen in which the antennae after the sixth segment and the abdomen are missing. However, as it is structurally very distinct and forms part of an interesting mimetic assemblage, I have decided to describe it.

Female. Testaceous-yellow except :—The head above the antennae, antennae segments 4–6 and dorsal surface of 3, a small spot on sides of pronotal collar, a few small marks on mesopleuron, metapleuron above the metapleural keel, dorsal aspect of mesonotum and propodeum, a streak on outer and inner surface of hind coxae, which are blackish-brown. Wings yellowish-hyaline. Pubescence brilliant brassy. Length probably about 13 mm.

Occiput smooth, moderately shining. Eyes distinctly closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by two-thirds their diameter from eyes, by a little more from one another. Vertex dull, densely alutaceous, with sparse, rather large, shallow punctures. Supra-antennal keel a moderately strong prominence bearing a fine keel. Limiting keels of antennal scrobes forming a transverse angulated keel emitting a fine keel between the sockets. Antennal sockets separated by rather less than half their diameter. Antennae with scape two and a half times as long as greatest width, 3 four times as long as broad, much shorter than 4 + 5, 4 hardly longer than 5 which is two and two-thirds times as long as broad. Clypeus with apical margin very slightly produced over its central quarter, the projection very weakly emarginate, the surface with rather sparse outstanding bristles. Occipital keel incomplete, horizontal space behind the buccal cavity rather broad. Tempora beneath shining, unsculptured. Stipes of maxillae dull, alutaceous. Proepisternal keel obsolete. Centre and lateral angles of pronotal collar not at all prominent, lateral tubercles weak, rounded. Mesopleuron shining, finely and not very closely punctured. Pleural suture obsolete. Mesonotum and scutellum moderately shining, finely and closely punctured, the latter moderately convex. Metanotum nearly flat, finely punctured, lateral lobes coriaceous, posterior margin rather broadly hyaline, depressions rather large and deep. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal area not all defined, smooth and shining, central longitudinal impression rather narrow, crossed by a few weak striae. Posterior surface with a narrow furrow, well defined above, ending at one-third its length from orifice, no keeled depression, orifice with dorsal margin hardly downcurved, angles with no keels, smooth, unsculptured. Sides not defined above, smooth and shining. Fore coxae with practically no strong bristles at apex. Hind coxae with a strong, pointed tubercle ventrally just before apex.

Type. ♀, Bolivia (V.).

T. cameronii Dalla Torre (1897).

(= *T. palliditarse* Cameron (1889) *nec* Saussure; = *T. tabascense* Strand (1910)).

Male. Black, underside of first two antennal segments, apex of clypeus, mandibles, slight tinge of apices of basal abdominal tergites, reddish-yellow. Narrow apex of fore femora, base and apex of fore and mid tibiae, base of hind tibiae, fore tarsi, basal annulations of each segment of four hind tarsi, whitish-yellow. Wings hyaline. Pubescence silvery. Length 10 mm.

Occiput a little raised behind the two lateral ocelli, smooth and shining. Eyes considerably closer together below than above, on occiput separated by a distance equal to length of antennal segments 3 + 4. Lateral ocelli in a common smooth depression, separated by two-thirds their diameter from eyes, by three-quarter diameters from one another. Vertex rather convex strongly and rather closely punctured, dull, central impression strong and including the median ocellus. Supraantennal keel a little raised in front, dying away behind where it is shortly bifurcate. Limiting keels of antennal scrobes forming an angulated transverse keel. Antennal sockets separated by one-quarter their diameter. Antennae with scape twice as long as greatest width, 3 twice as long as broad, 4 one and a half times as long as broad, 3 and 4 and base of 5 on outer side with a fringe of white hairs, 5 a little longer than broad, its apex a little contracted, 6 strongly thickened and excised at base, 10–12 transverse, 13 thickened at base, tapering to apex, rather longer than 9 + 10 + 11 + 12. Clypeus little produced with a small trapezoidal projection, surface with very sparse bristles; seen from beneath apex of clypeus is truncate and projection is deeply excavated. Occipital keel incomplete, horizontal space behind the buccal cavity very narrow. Tempora beneath shining, very finely and sparsely punctured. Stipes of maxillae shining, unpunctured. Proepisternal keel indicated at sides and near centre produced into a strong, blunt tooth bearing a tuft of white hairs at its apex. Pronotum with angles of collar rounded, centre hardly prominent, lateral tubercle weak and rounded. Mesopleuron sparsely and rather finely punctured. Pleural suture not developed. Mesonotum with a longitudinal tubercle on each side of disc, rather coarsely and shallowly and rather closely punctured. Scutellum flat, obsoletely punctured. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions deep. Area beneath metapleural keel weakly defined. Metasternum not emarginate. Propodeum with dorsal surface weakly defined by a U-shaped furrow, with a very weak central longitudinal impression, surface with nearly obsolete, curved striae. Posterior surface with a deep furrow, well defined above, separated by half its length from orifice, not crossed by striae, keeled depression weakly defined, longitudinally bisected, each half a little longer than broad, dorsal margin of orifice a little downcurved, angles with no keels, with rather strong transverse striae. Sides smooth and shining, well defined above. First abdominal tergite with a furrow for half its length, spiracular area rather broader than long, apophyses subobsolete, tergite at base rather broader than length of hind trochanter, about one- and two-thirds times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as long as apical width. First tergite hardly, second not contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Type. ♂, Mexico, Teapa, Tabasco, March (*H. H. Smith*) (B.C.A.) (type of *T. palliditarse* Cameron). Paratype. Another ♂ with the same data.

T. ornatipes Fox (1891).

Male. Black, underside of first two antennal segments and of third indeterminately, mandibles and tegulae, pronotal tubercles, posterior lobes of mesosternum, legs (except base of fore and hind coxae, apex of hind tibiae and of each hind tarsal segment) yellow. Wings hyaline. Pubescence silvery. Length 6 mm.

Occiput shining, hardly punctured. Eyes at clypeus separated by half the distance they are on occiput where they are separated by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by nearly their diameter from eyes, by nearly two diameters from one another. Vertex a little raised over a large central area, densely alutaceous and dull with rather close and nearly obsolete punctures, no central impression. Supraantennal keel fine, little raised. Limiting keels of antennal scrobes forming a sharply angled transverse keel emitting a fine one between the sockets. Antennal sockets separated by a little less than half their diameter. Antennae with scape two and a quarter times as long as broad in middle, 2 and 3 quadrate, 4 as long as 5, one and a half times as long as broad, 6 considerably thickened and produced almost into a tooth beneath at apex, as long as 5, 7 somewhat thickened at base beneath, 7–12 transverse, 10 beneath contracted at base and thickened at apex, 13 somewhat ovate, two and two-thirds times as long as broad, as long as 9 + 10 + 11 + 12. Clypeus shallowly emarginate over its whole width, in centre of apical margin with a small lobe taking up one-fifth of its whole width. Occipital keel incomplete, horizontal space behind buccal cavity moderately broad. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel obsolete, tubercle raised into a strong pointed tooth bearing a tuft of pubescence. Pronotum with centre and angles of collar not at all prominent, lateral tubercles very weak. Mesopleuron moderately shining, moderately closely and very finely punctured. Pleural suture obsolete. Mesonotum moderately shining, finely alutaceous, closely and finely punctured, scutellum rather more strongly punctured, flat. Metanotum somewhat convex, finely punctured, lateral lobes striate with a broad hyaline posterior margin, depressions small and deep. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal surface shining, obsoletely defined by a feeble U-shaped furrow, with a distinct central longitudinal impression, crossed by very weak striae which tend to be more diagonal at base. Posterior surface with a deep narrow furrow, well defined above and ending at half its length from orifice, no keeled depression but traces of a central keel in its position, orifice with dorsal margin a little downcurved, angles with no keels, shining, obsoletely rugose. Sides not defined above, smooth and shining. First abdominal tergite with no furrow, spiracular area a little broader than long, apophyses obsolete, tergite at base as wide as length of hind trochanter, twice as broad at apex, as long as hind femur. Second tergite two-thirds as long as first, as long as broad. First and second tergites not contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Specimens examined: ♂, U.S.A., Pennsylvania, Hummelstown, on *Carpinus* (*J. N. Knull*) (W.) (compared with type by Miss G. Sandhouse).

T. arroyense sp. n.

Male. Black, underside of first two segments of antennae, apex of clypeus, mandibles, pronotal tubercles and tegulae, underside of fore femora, fore tibiae and tarsi, narrow apex of four hind femora, mid tibiae and tarsi, base of hind tibiae and hind tarsi except for the darker apices of each segment, whitish-yellow. (Eyes probably green in life.) Wings hyaline. Pubescence silvery. Length 8·5 mm.

Occiput moderately shining, finely sculptured. Eyes distinctly closer at clypeus than on occiput where separated by a distance equal to length of segments 1 + 2 + 3 of antennae. Ocelli separated by two-thirds their diameter from eyes, by three-quarters of their diameter from one another. Vertex dull, rather strongly puncto-coriaceous, central impression very weak. Supraantennal keel fine, anteriorly, with the limiting keels of the antennal scrobes, forming a transverse angulated keel, closely associated with sockets. Antennal sockets separated by one-third their diameter. Antennae with scape one and a half times as long as greatest width, 3 quadrate, 4 twice as long as broad, 5 a little shorter, 6 one and a half times as long as broad, emarginate beneath, being thickened in middle and before apex where it is produced under 7, 7–12 transverse, 10 swollen at apex beneath, 13 swollen at base, tapering to apex, a little longer than 10 + 11 + 12. Clypeus with centre of apical margin produced into a small trapezoidal lobe. Occipital keel incomplete, horizontal space behind buccal cavity moderately broad. Tempora beneath finely and rather closely punctured. Stipes of maxillae smooth and shining. Proepisternal keel merely indicated by a small lateral process, but tubercle near centre produced into a strong rounded tooth bearing a tuft of pubescence. Pronotum with angles of collar not prominent, lateral tubercle weak, rounded. Mesopleuron shining, finely and closely punctured. Pleural suture obsolete. Mesonotum and scutellum somewhat dull, finely and closely punctured, the latter nearly flat. Metanotum flat, finely punctured, lateral lobes striate, posterior margin hyaline, depressions deep. Area beneath the metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal surface not defined, finely punctured with a faint longitudinal furrow crossed by ten curved striae. Posterior surface with a moderately deep furrow, well defined above, ending at its own length from the orifice, not crossed by any keels below, surface smooth, no keeled depression, orifice with upper margin sharp-edged but not produced, angles without keels, smooth. Sides smooth and shining, not defined above except weakly posteriorly. First abdominal tergite with a furrow for nearly half its length, spiracular area quadrate, apophyses subobsolete, tergite at base rather broader than length of hind trochanter, one and a half times as broad at apex, not much longer than hind femur, shorter than hind femur + trochanter. Second tergite little shorter than first, one and a half times as long as apical width. First and second tergites hardly contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Type. ♂, Mexico, Dos Arroyos, Guerrero, 1000 ft., Sept. (*H. H. Smith*) (B.C.A.). Paratype. ♂, Panama, Trinidad Rio, 30 March '12 (W.).

The type was confused by Cameron with his *T. pallidítarse* (= *T. cameronii* Dalla Torre).

T. cinctellum sp. n.

Female. Black, antennae with segments 1–2 beneath, whole of 3, base 4, mandibles, palpi, edge of pronotal collar and tubercles, tegulae, basal half of abdomen, base of hind basitarsus and annulations of remaining hind tarsal segments, pale testaceous. Wings hyaline. Pubescence silvery. Length 10 mm.

Occiput smooth and shining, immediately behind ocelli sinking at an angle not in the usual smooth curve. Eyes separated by half the distance at clypeus that they are on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by one-quarter their diameter from eyes, by two-thirds their diameter from each other. Vertex moderately shining, very finely alutaceous with rather close and fine, shallow punctures, central impression very weak. Supraantennal keel very weak, hardly as long as width of scape, situated on a slight prominence. Limiting keels of antennal scrobes forming an angulated transverse keel. Antennal sockets separated by two-thirds their diameter. Antennae with scape twice as long as its greatest width, 3 three and a half times as long as broad, much shorter than 4 + 5, 4 hardly longer than 5, about two and a quarter times as long as broad, remaining segments all a little longer than broad, 12 about two and a half times as long as broad, as long as 10 + 11. Clypeus with two very slight rounded projections in centre of apical margin, surface with sparse outstanding bristles. Occipital keel complete, horizontal space about as broad as length of second antennal segment. Tempora beneath shining, unpunctured. Stipes of maxillae shining, faintly alutaceous. Proepisternal keel obsolete, tubercle hardly prominent. Pronotum with the angles of collar rather prominent, lateral tubercles subobsolete. Mesopleuron shining, sparsely and obsoletely punctured. Pleural suture extending half-way up the pleuron. Mesonotum and scutellum shining, practically unpunctured, the latter somewhat convex. Metanotum flat, scarcely punctured, lateral lobes striate, with a broad hyaline posterior margin, depressions large and deep. Area beneath metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal surface rather strongly defined by a U-shaped furrow, with a moderately strong central longitudinal depression, actual base a little raised up to level of metanotum, just posterior to this transversely impressed, the impression crossed by longitudinal striae, posteriorly to this there are two smooth (apically diagonally striate) areas on each side of the central impression which is strongly transversely striate. Posterior surface with a broad shallow furrow, ill-defined above, with two strong transverse keels in lower half and below them a strong keeled depression which is divided down the centre by a strong keel, the halves so produced being rather longer than broad and separately curved above, orifice with its dorsal margin a little downcurved, angles with keels very short, in lower half almost unsculptured, above crossed by 6–7 strong striae. Sides smooth and shining, with hardly visible traces of striae, with a fine keel curving up just in front of hind coxae, well defined above. Fore coxae with only short pubescence at apex. Hind coxae with a strong, pointed tubercle on inner edge of ventral surface near apex. First abdominal tergite with a furrow for two-thirds of its length, spiracular area one and a half times as long as broad, apophyses subobsolete, tergite at base as broad as length of hind trochanter, two and a half times as broad at apex, as long as hind femur + trochanter. Second tergite half as long as first, as long as apical width. First tergite rather strongly, second very little contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Type. ♀, Panama, Barro Colorado Is., 27 March '29 (*S. W. Frost*) (W.).

T. grenadense sp. n.

Female. Black, apex of clypeus narrowly, mandibles, fore tibiae except dorsal streak, fore tarsi, mid tibiae indeterminately, mid tarsi, reddish. Wings hyaline. Pubescence silvery. Length 7 mm.

Occiput smooth and shining. Eyes much closer at the clypeus than on occiput where separated by a distance equal to the length of antennal segments 3 + 4. Ocelli separated by two-thirds their diameter from the eyes, by nearly one diameter from one another. Vertex somewhat dull, very finely alutaceous, closely and very shallowly punctured, central impression very weak. Supraantennal keel little raised, bearing a very fine keel. Limiting keels of antennal scrobes in the form of an obtusely angulated transverse keel. Antennal sockets separated by half their diameter. Antennae with scape nearly twice as long as greatest width, 3 three times as long as broad, remaining segments missing. Clypeus with apical margin produced into two small, blunt, central teeth. Occipital keel complete, horizontal space behind buccal cavity narrow. Tempora beneath smooth, unsculptured. Stipes of maxillae smooth, unsculptured. Proepisternal keel obsolete, tubercle not prominent. Pronotum with centre and lateral angles of collar rather prominent, lateral tubercles weak and rounded. Mesopleuron very finely and sparsely punctured. Pleural suture obsolete. Mesonotum and scutellum shining, practically unpunctured, the latter convex. Metanotum nearly flat, unpunctured, lateral lobes striate, posterior margin not hyaline, depressions large, pyriform. Area beneath metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal surface not defined, flat, unpunctured with a shallow central impression crossed by 6–7 very weak striae. Posterior surface with a deep, broad furrow, separated by half its length from the orifice, not well defined above, crossed below by a few very weak keels, no keeled depression, orifice with dorsal margin a little downcurved, angles without keels, smooth and shining. Sides smooth and shining, well defined above. Fore coxae with no strong bristles at apex. Hind coxae with a small ventral tubercle just before apex. First abdominal tergite with a furrow for half its length, spiracular area quadrate, apophyses obsolete, tergite at base as wide as length of hind trochanter, twice as wide at apex, as long as hind femur. Second tergite a little more than half as long as first, one and a quarter times as long as broad at apex. First tergite slightly, second little contracted at apex. Sixth tergite unkeeled. Sternites pubescent, basally hidden by strongly deflexed tergites.

Male. Ocelli separated by three-quarters their diameter from eyes, by the same distance from one another. Antennae with scape one and two-thirds times as long as its greatest width, 3 hardly longer than 4 which is twice as long as broad, 5 one and a half times as long as broad, 6 distinctly thickened and emarginate beneath, 5–10 with fine ventral keels, 11 quadrate, 12 just transverse, 13 twice as long as broad, as long as 10 + 11. Clypeus with the apical margin nearly straight. Proepisternal tubercle produced into a strong lamella. Impression of dorsal area of propodeum weaker, not crossed by keels. Seventh tergite simple.

Type. ♂, West Indies, Beecher (L.). Allotype. ♀, with same data (L.). Paratype. ♂, B.W.I., Grenada, Balthazar (*H. H. Smith*) (W.).

T. nitidissimum sp. n.

Male. Black, mandibles, margins of pronotal tubercles, front tibiae and tarsi, very narrow base of four posterior tibiae, somewhat paler. Wings hyaline. Pubescence silvery. Length 7 mm.

Occiput smooth and shining. Eyes at clypeus barely separated by more than half the distance at clypeus that they are on occiput where separated by distance equal to the length of antennal segments 2 + 3 + 4. Ocelli separated by their diameter from eyes, by one diameter from one another. Vertex brightly shining, finely and closely punctured, somewhat impressed in the centre. Supraantennal keel moderately raised, narrow. Limiting keels of antennal scrobes forming a very obtusely angulated transverse keel. Antennal sockets separated by two-thirds their diameter. Antennae with scape nearly three times as long as its greatest width, 3 two and a half times as long as broad, much shorter than 4 + 5, 4 and 5 of equal length, nearly twice as long as broad, 6 dorsally a little longer than 5, 7–10 quadrate, 11 and 12 transverse, 13 ovate, two and a half times as long as broad, as long as 10 + 11 + 12, 6 ventrally thickened at base and apex, excised between, 10 thickened beneath. Clypeus evenly rounded at apex before which there is a slight transverse impression. Occipital keel complete, horizontal space behind the buccal cavity rather broad, as broad as length of antennal segment 4. Tempora beneath smooth and shining. Stipes of maxillae alutaceous. Proepisternal keel obsolete but the tubercle produced into a very large lamelliform process. Pronotum with centre and angles of collar not at all prominent, lateral tubercles weak and rounded. Mesopleuron shining, unsculptured. Pleural suture obsolete. Mesonotum and scutellum shining, unpunctured, the latter moderately convex. Metanotum flat, lateral lobes striate, posterior margin not hyaline, depressions small and deep. Area beneath metapleural keel hardly defined. Metasternum with a very small V-shaped emargination. Propodeum with dorsal surface smooth and shining, not defined, central longitudinal impression weak. Posterior surface with a rather deep furrow, well defined above but gradually shallowing out below, no keeled depression, orifice with its dorsal margin a little downcurved, angles with short keels, unsculptured. Sides well defined above, shining and unsculptured. First abdominal tergite with a furrow for nearly half its length, spiracular area quadrate, apophyses nearly obsolete, tergite at base as wide as length of hind trochanter, two and a half times as wide at apex, about as long as hind femur + trochanter + coxa. Second tergite half as long as first, as long as apical width. First and second tergites both very little contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Type. ♂, Brazil, Para (L.). Paratypes. 2 ♂♂, the same locality, 6 and 11 March '02 (*Ducke*) (V.); ♂, Bolivia, Carinas Beni, Jan. (*W. M. Mann*) (W).

The following female probably belongs to this species:—

Length 9 mm. Wings a little darkened. Eyes separated on occiput by a distance equal to the length of antennal segments 2 + 3. Ocelli separated by two-thirds their diameter from eyes, by their diameter from one another. Vertex a little less shining, finely alutaceous. Antennae with scape about twice as long as greatest width, 3 four times as long as broad, much shorter than 4 + 5, 4 a little longer than 5 which is about two and two-thirds times as long as broad, 6–11 progressively shorter, all a little longer than broad, 12 twice as long as broad, shorter than 10 + 11. Central quarter of clypeus produced into a trapezoidal lamella. Proepisternal keel obsolete, tubercle not prominent. Lateral tubercles of pronotum stronger. Lateral lobe of postnotum black, hardly raised. Sixth tergite unkeeled.

♀, Bolivia, Coroico (B.).

T. urichi sp. n.

Male. Black, first two antennal segments beneath, apex of clypeus, mandibles, tegulae, fore tibiae and tarsi, mid tibiae and annulations of mid tarsi, basal quarter of hind tibiae, whitish. Wings hyaline. Pubescence silvery. Length 6·5 mm.

Occiput smooth and shining. Eyes separated at clypeus by half the distance that they are on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4. Ocelli separated by three-quarters their diameter from eyes, by their diameter from one another. Vertex shining, finely and rather closely punctured, central impression obsolete. Supraantennal keel obsolete. Limiting keels of antennal scrobes forming a nearly straight transverse keel. Antennal sockets separated by one-third their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 two and a third times as long as broad, shorter than 4 + 5, 4 distinctly longer than 5 which is a little longer than quadrate, 6–8 a little longer than quadrate, 6 thickened beneath, 5 and 6 together bounding a joint emargination beneath, 9–10 quadrate, 11–12 transverse, 13 three times as long as broad, nearly as long as 9 + 10 + 11 + 12. Clypeus with apical margin forming a flattened curve somewhat sinuous in centre. Occipital keel strong, complete, horizontal space behind the buccal cavity broad, one and a half times as wide as width of fore basitarsus. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel obsolete, but tubercle and another slight prominence between it and centre distinctly raised and bearing dense white pubescence. Pronotum with centre somewhat and angles of collar not at all prominent, lateral tubercles obsolete. Mesopleuron smooth and shining. Pleural suture not developed. Mesonotum and scutellum smooth and shining, the latter moderately convex. Metanotum flat, lateral lobes with posterior margin not hyaline, depressions deep. Area beneath metapleural keel defined. Metasternum very narrowly emarginate. Propodeum with dorsal surface smooth and very shining, not defined, central impression weak crossed by about 9 weak striae. Posterior surface with a moderately deep and narrow furrow, well defined above, crossed by two weak striae, becoming very shallow before reaching the orifice, no keeled depression, orifice with dorsal margin just downcurved, angles with no keels, unsculptured. Sides hardly defined above, smooth and shining, with a distinct keel curving up in front of hind coxae. First abdominal tergite with a furrow for half its length, spiracular area quadrate, apophyses weak, tergite at base as wide as length of hind trochanter, nearly twice as wide at apex, as long as hind femur + trochanter. Second tergite rather longer than half first, one and a half times as long as apical width. First and second tergites very little contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Type. ♂, B.W.I., Trinidad, Maracas Falls, 28 July '25 (*H. M. Rohwer*)

(W.). Paratypes. 3 ♂♂, Panama, Trinidad R. : 1, 19 March, 2, 28 March '12 (*A. Busck*) (W.).

T. rubrifemoratum sp. n.

Female. Black, apex of clypeus, mandibles, palpi, pronotal tubercles, tegulae and base and sides of third abdominal tergite, testaceous. Fore coxae and trochanters indeterminately, rest of fore legs except annulations of tarsi, mid legs except dorsally brownish coxae and trochanters, narrow base of hind tibiae, reddish. Wings hyaline. Pubescence silvery. Length 7 mm.

Occiput shining, sparsely punctured. Eyes at clypeus separated by half as much as they are on occiput where separated by a distance longer than length of antennal segments 3 + 4. Ocelli separated by two-thirds their diameter from eyes, by their diameter from one another. Vertex shining, finely, closely and shallowly punctured, central impression obsolete. Supraantennal keel practically obsolete. Limiting keels of antennal scrobes forming a weak (nearly obsolete), little curved transverse keel. Antennal sockets separated by half their diameter. Antennae with scape and second segment with unusually dense, short ventral hairs, scape not quite twice as long as greatest width, 3 three and a half times as long as broad, much shorter than 4 + 5, 4 as long as 5 which is two and a half times as long as broad, 6–11 subequal, a little longer than broad, 12 a little shorter than 10 + 11, twice as long as broad. Clypeus with apex a little upturned, central quarter forming a slight trapezoidal projection, surface with rather numerous outstanding bristles. Occipital keel complete, horizontal space behind the buccal cavity narrow, rather narrower than width of fore basitarsus. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel obsolete, tubercle not prominent. Pronotum with centre and angles not prominent, lateral tubercles weak. Mesopleuron shining, almost impunctate. Pleural suture obsolete. Mesonotum and scutellum shining, almost impunctate, the latter flat. Metanotum duller, moderately convex, lateral lobes striate, posterior margin not hyaline, depressions not large. Area beneath the metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal surface not defined, smooth and shining, central longitudinal impression feeble, crossed by about eight weak striae. Posterior surface with a broad shallow furrow, well defined above, ending at nearly its own length from orifice in three transverse keels of which the lowermost forms the upper limit of the keeled depression which is bisected by a longitudinal keel, each half being a little longer than broad, orifice with dorsal margin a little downcurved, angles with keels nearly obsolete, smooth and shining with traces of striae laterally only. Sides smooth and shining, well defined above. Fore coxae with no bristles at apex. Hind coxae with a small, perforated, ventral tubercle near apex. First abdominal tergite with a furrow for nearly half its length, spiracular area quadrate, apophyses nearly obsolete, tergite at base as broad as the length of hind trochanter, twice as broad at apex, nearly as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as long as apical width. First moderately, second very little contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Type. ♀, Panama, Paraiso, 8 Feb. '11 (*A. Busck*) (W.). Paratype. ♀, B.W.I., Trinidad, Oct. '33 (*D. Vesey FitzGerald*) (L.).

var. **rubellum** var. n.

Female. Similar, but mid femora with a dark posterior mark, abdomen with segments 2–3 red with a small apical dorsal spot, sides and a narrow base of 4 red. Length 8·5 mm.

Limiting keels of antennal scrobes almost quite obsolete. Furrow of posterior surface of propodeum crossed by three striae but keeled depression scarcely defined, angles with stronger striae. Second abdominal tergite nearly twice as long as broad.

Type. ♀, N. Argentine, Salta (*Steinbach*) (B.).

T. leucarthrum sp. n.

Female. Black, mouth-parts, apex of clypeus, antennal segments 1 and 2 beneath, tegulae, posterior margin of pronotum, of mesosternum and of propodeum, fore legs except dorsal streak on femora, mid legs except base of coxa, dorsal half of femora and tarsi, base of mid basitarsus, hind trochanter, basal half of hind tibia and hind basitarsus, yellowish-white. Abdomen with segment 1 black, reddish at sides, segment 2 reddish with a dark dorsal mark, segments 3–6 reddish. Wings hyaline. Pubescence silvery. Length 12 mm.

Occiput shining, very finely punctured. Eyes much closer together at clypeus than on occiput where separated by a distance hardly greater than length of antennal segment 3. Ocelli separated by less than a quarter their diameter from eyes, by two-thirds their diameter from one another. Vertex dull, alutaceous, finely and very closely punctured, central impression strong. Supraantennal keel very strong, as long as scape, slightly bifurcated posteriorly. Limiting keels of antennal scrobes absent. Antennal sockets separated by one-third their diameter. Antennae with scape nearly twice as long as its greatest width, 3 three and a half times as long as broad, much shorter than 4 + 5, 4 and 5 nearly three times as long as broad, remaining segments all much longer than broad, 12 nearly three times as long as broad. Clypeus with apical margin gently rounded, surface with appressed pubescence and a vertical row of four long outstanding bristles on each side. Labrum very strongly bilobed. Occipital keel nearly complete, horizontal space behind the buccal cavity moderately broad, broader than width of fore basitarsus. Tempora beneath moderately shining, closely and finely punctured. Stipes of maxillae moderately shining, weakly alutaceous. Proepisternal keel weak and rounded, tubercle hardly prominent. Pronotum with centre of collar a little prominent, angles rounded, lateral tubercles weak and rounded. Mesopleuron dull, alutaceous, very closely and finely punctured. Pleural suture obsolete. Mesonotum and scutellum dull, alutaceous, finely and very closely punctured. Metanotum moderately convex, closely punctured, lateral lobes crossed by two keels, posterior margin hyaline, depressions deep and pyriform. Area beneath the metapleural keel not defined. Metasternal emargination linear. Propodeum with dorsal surface moderately well defined by a ⋃-shaped furrow, with a weak central depression, dull, with very fine, regular striae which are diagonal at base and more transverse at apex. Posterior surface with a shallow furrow, not well defined above, ending before the orifice, no keeled depression, dorsal margin of orifice produced into a small projecting lobe, angles dull, finely punctate with traces of striae below. Sides smooth, well defined above. Fore coxae with a single, short but stout, apical bristle. Hind coxae with no ventral organ. First abdominal tergite with no furrow, spiracular area a little longer than broad, apophyses very weak, tergite at base as broad as length of hind trochanter, two and a half times as broad at apex, nearly as long as hind femur + trochanter + coxa, basal half parallel-sided. Second tergite half as long as first, twice as long as its apical width. Sixth tergite unkeeled, apical sternites pubescent.

Type. ♀, B.W.I., Trinidad, 2 Sept. '33, no. 2334 (*D. Vesey FitzGerald*) (L.).

This species is close to *T. pachygaster* sp. n., but the mesothorax is duller and more finely punctured, the dorsal surface of the propodeum is more closely striate and the dorsal margin of the orifice is produced into a lobe.

T. manni sp. n.

Female. Black, antennal segments 1–2, especially beneath, apex of clypeus, mandibles, palpi, pronotal tubercles, tegulae, posterior lobes of mesosternum, apex of all femora, all tibiae, fore tarsi, hind basitarsus, sides of first abdominal tergite, sides basally and sternite of 2, base and sternite of 3, sides and venter of 4–6, yellowish. Wings hyaline, hardly darker at apex. Pubescence silvery. Length 9·5 mm.

Occiput shining, almost unsculptured. Eyes almost twice as close together at clypeus as on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by half their diameter from eyes, by their diameter from one another. Vertex dull, densely alutaceous, with fine, moderately close, flat-bottomed punctures, central impression weak. Supraantennal keel distinctly prominent, hardly keeled, three-quarters as long as scape. Limiting keels of antennal scrobes forming a rather weak transverse keel, emitting a very weak keel between the sockets. Antennal sockets separated by half their diameter. Antennae with scape nearly twice as long as its greatest width, 3 four times as long as broad, a little shorter than 4 + 5, 4 a little longer than 5 which is twice as long as broad, 6–11 progressively shorter, all a little longer than broad, 12 nearly twice as long as broad, shorter than 10 + 11. Clypeus with apical margin rounded, with moderately dense outstanding hairs. Occipital keel complete, horizontal space behind buccal cavity moderately broad, one and a half times as wide as width of fore basitarsus. Tempora beneath shining, unsculptured. Stipes of maxillae shining, unsculptured. Proepisternal keel obsolete, tubercle not prominent, bearing a tuft of pubescence. Pronotum with centre and angles of collar little prominent, lateral tubercles subobsolete. Mesopleuron shining, finely and rather closely punctured. Mesopleural suture obsolete. Mesonotum and scutellum moderately shining, finely and not very closely punctured, the latter convex. Metanotum convex, obsoletely punctured, lateral lobes with posterior margin not hyaline, depressions shallow. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal surface not defined, central impression weak, crossed by two or three weak transverse striae. Posterior surface with a broad shallow furrow, well defined above, shallowing out completely at half its length from orifice, no keeled depression, orifice with dorsal margin produced into a small lobe, angles with very short keels, finely and obsoletely striate. Sides shining, unsculptured, defined above anteriorly only. Fore coxae with no strong bristles at apex. Hind coxae without a ventral tubercle. First abdominal tergite with a short, weak furrow, spiracular area one and a half times as long as broad, apophyses weak, rounded, tergite at base hardly as broad as length of hind trochanter, two and a half times as broad at apex, as nearly long as hind femur + trochanter + coxa. Second tergite two-thirds as long as first, two and a half times as long as apical width. First tergite hardly, second not contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Male. Similar, but ocelli separated by half their diameter from eyes and from one another. Antennae with penultimate segments quadrate, 13 twice as long as broad. Clypeus with few outstanding bristles. Seventh tergite simple.

Type. ♀, Brazil, Para, no. 56 (*W. M. Mann*) (W.). Allotype. ♂, Trinidad, 13 May '33 (*D. Vesey FitzGerald*) (L.). Paratypes. 3 ♀♀, Brazil, Para (*Schulz*) (B.); Trinidad, ♀ 30 April '33 (*D. Vesey FitzGerald*) (L.).

The Trinidad specimens are distinctly darker, the hind tibiae being pale only on the basal quarter while the abdomen is black with only the base of the third tergite narrowly pale.

T. silvestre sp. n.

Female. Black, antennae with scape beneath, apex of segment 2, apical half of clypeus, mandibles, pronotal tubercles, tegulae, apex of fore femora, fore tibiae except apex, fore tarsi, base and apex of mid tibiae, base of mid basitarsus and annulations of other segments, base of hind tibiae, base of hind basitarsus and annulations of other segments, yellowish-white. Abdomen red, tergite 1 and apex of 2 black. Wings hyaline. Pubescence silvery. Length 13 mm.

Occiput shining, weakly sculptured. Eyes distinctly closer at clypeus than on occiput where they are separated by a distance equal to length of antennal segment 3. Ocelli in a slight depression, separated by one-third their diameter from eyes, by less than two-thirds diameter from one another. Vertex somewhat raised over a central oval area, dull, densely alutaceous, with sparse, moderately large punctures, central impression strong, including the median ocellus, its surface shining. Supraantennal keel moderately raised bearing a thick, shining, obtuse keel. Limiting keels of antennal scrobes forming a straight transverse keel. Antennal sockets separated by one-quarter their diameter. Antennae with scape twice as long as greatest width, 3 five times as long as broad, nearly as long as 4 + 5, 4 and 5 subequal about three times as long as broad, remaining segments all longer than broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus with margin evenly rounded, surface with rather dense outstanding bristles. Occipital keel complete, horizontal space behind the buccal cavity moderately broad. Tempora beneath shining, very finely and sparsely punctured. Stipes of maxillae finely punctured and densely hairy at base. Proepisternal keel obsolete, tubercle a little prominent, bearing dense pubescence. Pronotum with centre and angles of collar not prominent, lateral tubercles obsolete. Mesopleuron moderately closely and finely punctured, prepectus with no mesosternal keel. Pleural suture obsolete. Mesonotum and scutellum shining, closely and rather finely punctured, the latter nearly flat. Metanotum centrally impressed, lateral lobes striate, posterior margin broadly hyaline, depressions shallow. Area beneath metapleural keel not defined. Metasternum with a narrow emargination. Propodeum with dorsal surface moderately defined by a U-shaped furrow, central impression very weak, surface not very shining with striae that are diagonal at base and transverse at apex. Posterior surface with moderately deep furrow becoming obsolescent below, well defined above, no keeled depression, orifice with dorsal margin produced into a distinct lobe, angles without keels, finely striate. Sides shining, unpunctured, sharply defined above. Front coxae with moderately distinct bristles at apex. Hind coxae with no ventral tubercle. First abdominal tergite with furrow very short, spiracular area a little longer than broad, apophyses obsolete, tergite at base rather narrower than length of hind trochanter, two and a half times as wide at apex, a little longer than hind femur + trochanter. Second tergite rather more than two-thirds the length of first, two and a half times as long as apical width. First tergite distinctly, second not contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Cotypes. 4 ♀♀, British Guiana, Essequibo R., Moraballi Creek, 15 Aug. '29, no. 309 O.U.Exped. Brit. Guiana (L.) (nest hanging from underside of log). Paratypes. *British Guiana :* ♀, same data, no. 263 (another nest); ♀ same locality, 1 Nov. '29, no. 6420 O.U.Exped. Brit. Guiana (nest hanging from underside of palm leaf) (L.); ♀, Kalacoon, '16 (*P. G. Howes*) (W.); ♀, Kartabo, 16 Oct. '20 (W.).

T. rugifrons Smith (1873).

Female. Black, first three segments of antennae, apex of clypeus, mandibles, tegulae, legs except greater part of coxae basally, first three abdominal segments and sometimes part of the fourth, red yellow. Wings hyaline. Pubescence more or less brassy. Length 14 mm.

Occiput smooth and shining. Eyes equally separated at clypeus and on occiput where separated by a distance equal to length of antennal segment 3. Ocelli separated by half their diameter from eye, by two-thirds diameter from one another. Vertex shining, hardly alutaceous, strongly wrinkled, the edges of the depressions rounded, central impression distinct, including median ocellus. Supraantennal keel moderately raised, bearing a fine keel. Limiting keels antennal scrobes forming an angulated transverse keel. Antennal sockets separated by about two-thirds their diameter. Antennae with scape twice as long as the greatest width, 3 five times as long as broad, about as long as 4 + 5, 4 a little longer than 5 which is a little more than twice as long as broad, remaining segments becoming shorter but all a little longer than broad, 13 two and a half times as long as broad, nearly twice as long as 11. Clypeus with apical margin produced into an obtuse, rounded angle, surface with dense outstanding bristles. Occipital keel almost reaching keel defining buccal cavity behind which there is almost no horizontal area. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel represented by a strong tooth at sides. Pronotum with centre hardly, and angles of collar distinctly, prominent, lateral tubercles strong, produced into a rounded, triangular lobe. Mesopleuron shining, unpunctured. Pleural suture obsolete. Mesonotum and scutellum shining, unpunctured, the latter convex. Metanotum convex, centre slightly depressed, unpunctured, lateral lobes with posterior margin broadly hyaline, depressions deep. Area beneath metapleural keel not defined. Metasternum with a very narrow emargination. Propodeum with dorsal surface weakly defined by a U-shaped furrow, with a distinct central impression, smooth and shining. Posterior surface with a deep subcircular impression dorsally which sends down a feeble impressed line towards the orifice, keeled depression obsolete, orifice with the dorsal margin produced into a distinct lobe, angles with no keels, unsculptured. Sides smooth and shining, weakly defined above. Fore coxae with strong bristles at the apex. Hind coxae with no ventral tubercle. First abdominal tergite with almost no furrow, spiracular area three times as long as broad, apophyses strong, tergite parallel-sided for two-thirds of its length then suddenly expanding, at base not quite so broad as length of hind trochanter, three times as wide at apex, as long as hind femur + trochanter. Second tergite hardly more than half as long as first, three times as long as apical width. First tergite little, second not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Specimens examined: Type. ♀, Brazil, Upper Amazon, Ega (L.). Other specimens, *Brazil:* ♀, Smith coll. (L.); ♀, Bahia, Itaparica Is., 23 Sept. '23 (*G. L. R. Hancock*) (Bristowe).

T. balteatum Cameron (1889).

Female. Black, segments 1–5 of antennae, apex of clypeus, mandibles, all legs including coxae, posterior lobes of meso- and meta-sternum, base, sides and most of venter of first and second abdominal segments, nearly the whole of the third and sixth sternite, yellow red. Hind femora darker above. Wings hyaline faintly fuscous-yellow tinged. Pubescence brassy. Length 13 mm.

Occiput smooth and shining. Eyes rather closer at clypeus than on occiput where separated by the length of segments 2 + 3 of antennae. Ocelli in slight depressions, separated by rather less than half their diameter from eyes, by three-quarter diameters from one another. Vertex nearly unpunctured, densely alutaceous, dull, with a strong central impression including the median ocellus. Supraantennal keel little raised, in the form of a fine keel. Limiting keels of antennal scrobes forming a rounded transverse keel. Antennal sockets separated by two-thirds their diameter. Antennae with scape twice as long as greatest width, 3 four and a half times as long as broad, about as long as 4 + 5, 4 a little longer than 5 which is twice as long as broad, remaining segments missing. Clypeus somewhat produced, strongly curved, surface with rather dense outstanding hairs. Occipital keel incomplete, not quite reaching keel defining buccal cavity behind which there is almost no horizontal space. Tempora beneath shining, unpunctured. Stipes of maxillae smooth and shining. Proepisternal keel obliterated except for a small tooth behind the tubercle. Pronotum with angles of collar prominent, centre slightly so, lateral tubercles strong, triangular with apex rounded. Mesopleuron smooth and shining. Pleural suture obsolete. Mesonotum and scutellum shining, unpunctured, the latter convex. Metanotum convex, smooth and shining, lateral lobes striate, posterior margin not hyaline, depressions deep. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal surface defined by a fairly strong U-shaped furrow, within which it is distinctly raised, with a moderately strong central longitudinal depression crossed by several fine striae. Posterior surface with a broad shallow furrow, well defined above, crossed by 5–6 fine keels, no keeled depression, orifice with dorsal margin strongly produced, angles with short keels, surface striate laterally. Sides smooth and shining, hardly defined above, with a small keel extending upwards from in front of the hind coxae. First abdominal tergite with a very short furrow, spiracular area nearly three times as long as broad, apophyses moderately strong, tergite at base a little narrower than length of hind trochanters, parallel-sided for half its length, as long as femur + trochanter or a little longer. Second tergite a little longer than half the first, three times as long as broad at apex. First tergite slightly, second not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Male. Antennae 1–5 and base of 6, 13 beneath, apex of clypeus, mandibles, pronotal tubercles, tegulae, whole of four front legs except basal part of coxae (hind legs missing), sides and venter of first abdominal segment, basal half of tergite, sides and venter of second, basal two-thirds of tergite and whole venter of third, yellow. Wings hyaline. Pubescence brassy. Length 11·5 mm.

Ocelli separated by three-quarters their diameter from eyes, by their diameter from one another. Vertex brightly shining with irregular clathrate rugae the edges of which are not in the least sharp, central impression pyriform, deep, including the median ocellus. Supraantennal keel a little stronger. Limiting keels of antennal scrobes forming a rather more angulated transverse keel. Antennae with scape twice as long as greatest width, 3 five times as long as broad, a little longer than 4 + 5, 4 a little longer than 5, about twice as long as broad, 6–11 progressively shorter but 11 longer than quadrate, 13 twice as long as broad. Clypeus less produced with sparse outstanding hairs. Propodeum with furrow of posterior surface crossed by three keels, keels of angles stronger, angles smooth with striae at their lateral margin. Seventh tergite simple.

Specimens examined: Type. ♀, Mexico, Atoyac, Vera Cruz, May (*H. H. Smith*) (B.C.A.). Also ♂, Mexico (W.).

T. mazaruni sp. n.

Female. (Specimen perhaps a little immature.) Black, apex of clypeus, mandibles, margin of pronotal tubercles, tegulae, legs very indeterminately, sides of abdominal tergite, base and sternite of 2, broad base and sternite of 3, testaceous. Wings hyaline. Pubescence silvery. Length 11 mm.

Occiput smooth and shining. Eyes a little closer at clypeus than on occiput where separated by a distance equal to length of antennal segment 3. Ocelli separated by one-quarter their diameter from eyes, by two-thirds diameter from one another. Vertex raised over an ill-defined, central, circular area, including the median ocellus, moderately shining, finely alutaceous, with weak wrinkles radiating from the strong central impression which includes median ocellus. Supraantennal keel fine, not quite reaching the limiting keels in front. Limiting keels of antennal scrobes forming a very obtusely angled transverse keel emitting a rounded prominence between the sockets. Antennal sockets separated by nearly their diameter. Antennae with scape twice as long as greatest width, 3 four times as long as broad, nearly as long as 4 + 5, 4 a little shorter than 5 which is two and a half times as long as broad, remaining segments all at least a little longer than broad, 12 twice as long as broad, twice as long as 11. Clypeus with apical margin angularly rounded, surface with dense outstanding pubescence. Occipital keel complete, horizontal space behind buccal cavity narrow. Tempora beneath smooth, shining. Stipes of maxillae shining, unsculptured, with long pubescence at base. Proepisternal keel represented by a strong lateral tooth behind the strongly prominent but rounded tubercle. Pronotum with centre of collar hardly, angles distinctly prominent, lateral tubercles strongly and triangularly projecting. Mesopleuron smooth and shining. Pleural suture obsolete. Mesonotum and scutellum smooth and shining, the latter convex. Metanotum convex, unpunctured, lateral lobes with posterior margin narrowly hyaline, depressions large and deep. Area beneath metapleural keel not defined. Metasternum very narrowly emarginate. Propodeum with dorsal surface hardly defined, central longitudinal impression broad and deep, surface otherwise unsculptured. Posterior surface with a broad shallow furrow, moderately well defined above, with a narrow central part more deeply impressed and continued to orifice, no keeled depression, orifice with dorsal margin produced into a rather strong lobe, angles with short keels, unsculptured. Sides smooth and shining, not defined above. Fore coxae with strong bristles apex. Hind coxae with no ventral tubercle. First abdominal tergite with no furrow, spiracular area twice as long as broad, apophyses distinct but rounded, tergite at base narrower than length of hind trochanter, parallel-sided for half its length, two and a half times as broad at apex, a little longer than hind femur + trochanter. Second tergite a little longer than half the first, two and a half times as long as apical width. First tergite little, second hardly contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Male. Eyes much closer at clypeus than on occiput. Ocelli separated by one-third or more of their diameter from eyes. Vertex brightly shining with strong wrinkles which are, however, rounded. Antennae with 13 one and a half times as long as broad, 12 quadrate. Clypeus black, somewhat truncate, with very few outstanding bristles. Keels of angles of propodeum stronger. Second abdominal tergite less than half as long as first. Seventh tergite simple.

Type. ♀, and allotype and one paratype, ♂♂, British Guiana, R. Mazaruni, Tutruba, May '16 (*G. E. Bodkin*) (B.G.).

T. fabricator Smith (1873).

(= *gracile* Taschenberg (1875); = *brevicarinatum* Cameron (1912).)

Female. Black, antennae usually with apex of segments 1–2 pale beneath, more rarely with 1 entirely pale and 2–3 pale beneath; apex of clypeus, mandibles, tegulae, usually narrow apices of four front femora, narrow base of all tibiae, tarsi basally, pale. Abdomen with first three segments more brown with sides of tergites 1–3 and often base of 2 and 3 more or less pale. Wings hyaline. Pubescence silvery. Length 12 mm.

Occiput smooth and shining. Eyes a little closer together at clypeus than on occiput where separated by a distance equal to length of antennal segment 3. Ocelli separated by one-third their diameter from eyes, by two-thirds diameters from one another. Vertex dull, densely alutaceous, with at most feeble traces of very weak wrinkles, vertex somewhat raised over an oval central area, central depression strong and including the median ocellus. Supraantennal keel moderately raised, bearing a sharp keel. Limiting keels of antennal scrobes forming a more or less sharply angulated transverse keel. Antennal sockets with their edges not raised, separated by about half their diameter. Antennae with scape fully twice as long as greatest width, 3 four and a half times as long as broad, as long as 4 + 5, 4 and 5 subequal, about twice as long as broad, remaining segments progressively shorter, all longer than broad, 12 twice as long as broad, not as long as 10 + 11. Clypeus produced in a smooth curve, surface with dense outstanding pubescence. Occipital keel complete, horizontal space behind the buccal cavity narrow. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel visible only as a strong downwardly directed tooth at sides, tubercle also prominent.

Pronotum with angles of collar rather prominent, lateral tubercle strongly projecting, triangular. Mesopleuron shining, very finely and sparsely punctured. Pleural suture not developed. Mesonotum and scutellum shining, very finely and sparsely punctured, the latter convex. Metanotum convex, shining, lateral lobes striate, posterior margin broadly hyaline, depressions deep. Area beneath metapleural keel not defined. Metasternum narrowly emarginate. Propodeum with dorsal surface weakly defined by a U-shaped furrow, central depression shallow, broadening posteriorly, surface smooth and shining, depression crossed by four or five weak keels. Posterior surface with a broad, not very deep furrow, moderately defined above, shallowing out below where it is crossed by 2–5 weak striae (usually 4), no keeled depression, orifice with dorsal margin produced into a strong process, angles without keels, smooth. Sides ill-defined above, smooth and shining. Fore coxae with a tuft of strong bristles at the apex. Hind coxae with no ventral tubercle. First abdominal tergite with no furrow, spiracular area two and a half times as long as broad, apophyses rather strong but rounded, tergite at base narrower than length of hind trochanter, parallel-sided for two-thirds of its length, two and a half times as wide at apex, as long as hind femur + trochanter + coxa. Second tergite half as long as first, two and a half to three times as long as apical width. First tergite moderately, second not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Male. Ocelli separated by two-thirds their diameter from eyes, by three-quarter diameters from one another. Vertex shining, with strongly raised, almost sharp-edged rugosities. Antennae with segments rather shorter, 13 one and two-thirds times as long as broad, not as long as 11 + 12. Clypeus without outstanding pubescence. Fore coxa with no apical bristles. Propodeum with dorsal surface with stronger and more obvious striae, often some longitudinal ones at base. Angles with sparse transverse striae. Tergites and sternites simple.

Specimens examined: Type. ♀, Brazil (L.). Other specimens. *Panama:* 6 ♀♀, Paraiso, 5, 28 Jan., 1, 29 Jan. '11 (*A. Busck*) (W.); 3 ♂♂, 4 ♀♀, Ancon, 15 Dec. '21, nest in limetree, no. Z1574 (*J. Zetek*) (W.); ♀, Portobello, 4 March '11 (*A. Busck*) (W.); ♀, Pedro Miguel, 10 April '23 (*R. C. Shannon*) (W.). *Venezuela:* ♀ (type of *T. gracile* Taschenberg) (H.). *B.W.I.:* 2 ♂♂, 3 ♀♀, Trinidad (*E. B. Connel*) (L.); ♂, 2 ♀♀, Trinidad, Nov. '33, and ♂, Trinidad, 6 May '33 (*D. Vesey FitzGerald*) (L.). *British Guiana:* 2 ♀♀, Georgetown (*Satovnikov*) (B.); ♀, Georgetown, Botanic Gdns., 15 March '13 (*G. E. Bodkin*) (L.); 6 ♀♀, Georgetown, Botanic Gdns.: 3, 24 Dec., 2, March, and 1, 20 July (*G. E. Bodkin*) (B.G.); ♀ (type of *T. brevicarinatum* Cameron) (L.); ♀, Kalacoon, '16, no. 516 (*P. G. Howes*) (W.). *Brazil:* 3 ♂♂ (L.); 2 ♀♀, Ega (L.); ♀, Prov. Rio de Janeiro, Massif of Tijuca. Mts. of Orgues, '02 (*E. R. Wagner*) (P.); ♂♀, Para (*Schulz*) (B.); 2 ♂♂, 2 ♀♀, Rio de Janeiro (B.).

This species is rather more variable than most and there is some evidence from the material examined that specimens bred from one nest show a strong family resemblance. This applies both to colour and to the sculpture of the propodeum. The tarsi vary from the darkest type in which the hind tarsi are entirely dark and the four front tarsi are pale only on the basal half of the basitarsus to the lightest in which the basal half of the hind basitarsus is pale, most of the mid basitarsus is pale and the fore tarsi are pale except for the apical segment. The variation in the colour of the abdomen usually follows that of the tarsi more or less closely. In dark specimens the abdomen is scarcely paler at the base, in the light ones segments 2 and 3 are largely pale.

T. gounellei sp. n.

Female. Black, most of mandibles, palpi, sides and sternite of first abdominal segment, tergite 2 except apex, sides and basal spot on tergite of 3, testaceous. Tegulae pale tinged. Femora brown, tibiae and tarsi (except pulvillus) testaceous. Wings subhyaline. Pubescence dense, bright golden. Length 12·5 mm.

Occiput shining, unsculptured. Eyes a little closer together at clypeus than on occiput where separated by a distance nearly equal to length of antennal segments 2 + 3. Ocelli separated by one-third their diameter from eyes, by two-thirds their diameter from one another; lateral ocelli in slight pits. Vertex with a subcircular area a little raised, moderately shining, with strong irregular wrinkles and with a strong central depression including the median ocellus. Supraantennal keel weak, about as long as the scape of antennae. Limiting keels of antennal scrobes in the form of a transverse angulated keel. Antennal sockets with their edges not raised, separated by two-thirds their diameter. Antennae with scape about twice as long as greatest width, 3 about four and a half times as long as broad, as long as 4 + 5, 5 a little shorter than 4, about one and two-thirds times as long as broad, remaining segments successively a little shorter till 11 is only a little longer than broad, 12 twice as long as broad. Clypeus produced in a smooth curve in centre, surface with dense outstanding hairs. Occipital keel complete, horizontal space behind buccal cavity narrow. Tempora beneath smooth and shining. Stipes of maxillae smooth and shining. Proepisternal keel visible only as a small tooth behind the strongly prominent tubercle. Pronotum with the angles of the collar rather prominent, lateral tubercle in the form of a strong, projecting, triangular process. Mesopleuron shining, unpunctured. Pleural suture not developed. Mesonotum and scutellum shining, unpunctured, the latter convex. Metanotum convex, unpunctured, lateral lobes with no hyaline posterior margin, depressions deep and filled with pubescence. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal surface weakly defined by a U-shaped furrow, rather strongly raised with a strong, central longitudinal depression, surface with transverse striae which are especially visible in the depression. Posterior surface with a broad, shallow furrow, not well defined above and completely flattened out before the orifice, crossed by three or four weak keels near its centre, no keeled depression, orifice with dorsal margin produced into a strong process, angles without keels, unsculptured except for a few striae dorsally. Sides smooth and unpunctured, defined above by a weak furrow. Fore coxae with a tuft of strong bristles at the apex. Hind coxae with no ventral tubercle. First abdominal tergite with no furrow, spiracular area two and a half times longer than broad, apophyses moderately strong but rounded, tergite at base hardly as wide as length of hind trochanter, parallel-sided for more than half its length, nearly three times as wide at apex, as long as hind femur + trochanter. Second tergite half as long as first, twice as long as wide at apex. First and second tergites distinctly contracted at the apex. Sixth tergite with a keel on its apical quarter. Sternites 3–5 with a large apical, triangular area of pubescence.

Male. Legs darker, tibiae only pale at base, tarsi with one or two apical segments dark. Ocelli separated by nearly two-thirds their diameter from eyes. Vertex more strongly wrinkled. Antennae with segments rather shorter, 13 one and a half times longer than 12. Clypeus without outstanding hairs. Fore coxae without bristles at apex. Propodeum with furrow of posterior surface crossed by stronger striae, angles with distinct keels, and with strong, regular striae. Tergites and sternites simple.

Type. ♀, Brazil, S. Paulo, Carqueira Cesar, '99 (*E. Gounelle*) (P.). Allotype. ♂, with the same data and an ink label—" Les nids étaient fixé à la page inférieure d'une *Cattleyia*." Paratypes. ♂, 2 ♀♀, with the same data as the type; ♀, Rio de Janeiro (P.).

The male paratype has paler legs than the allotype.

T. trigeminum sp. n.

Female. Black, narrow apex and base of antennal scape and segment 2, mandibles, tegulae, narrow bases of all tibiae, fore tarsi, mid tarsi except apex, annulations of hind tarsi, sides of first and sides and venter of second and third abdominal segments indeterminately, pale yellowish. Wings hyaline, apex hardly darker. Pubescence silvery. Length 9·5 mm.

Occiput smooth and shining. Eyes a little closer on clypeus than they are on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli in small depressions, separated by one-third their diameter from eyes, by three-quarters their diameter from one another. Vertex with a deep central impression including the median ocellus, raised on each side, the raised part moderately shining, faintly alutaceous, with large irregular (but not elongate) depressions whose boundaries are absolutely rounded. Supraantennal keel strongly raised, bearing a fine keel. Limiting keels of antennal scrobes forming a strong, angulated, transverse keel emitting another one between the sockets. Antennal sockets separated by one-third their diameter. Antennae with scape twice as long as greatest width, 3 three times as long as broad, shorter than 4 + 5, 4 a little longer than 5 which is about twice as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad, nearly as long as 10 + 11. Clypeus with margin evenly rounded, surface with moderately dense outstanding bristles. Occipital keel complete, horizontal space behind the buccal cavity narrow. Tempora beneath smooth, shining. Stipes of maxillae sparsely punctured. Proepisternal keel forming a strong lamella behind the moderately prominent tubercle (lamella stronger than in *T. fabricator*). Pronotum with centre and angles of collar not prominent, lateral tubercles strong, forming pointed, triangular lobes. Mesopleuron shining, with very fine, sparse punctures. Pleural suture obsolete. Mesonotum and scutellum shining, sparsely and obsoletely punctured, the latter moderately convex. Metanotum convex, unpunctured, lateral lobes with posterior margin hyaline, depressions large and deep. Area beneath the metapleural keel defined. Metasternum narrowly emarginate. Propodeum with dorsal surface raised over area defined by a U-shaped furrow, central impression broad and shallow, crossed by three or four weak striae, otherwise smooth and shining. Posterior surface with a moderately broad and deep furrow, well defined above, crossed by two or three striae, no keeled depression, orifice with dorsal margin produced into a rounded lobe, angles with short keels, with irregular weak striae. Sides smooth and shining, well defined above, with traces of a keel curving up in front of hind coxae. Fore coxae with strong bristles at apex. Hind coxae with no ventral tubercle. First abdominal tergite with no furrow, spiracular area two and a half times as long as broad, apophyses obsolete, tergite at base distinctly narrower than length of hind trochanters, parallel-sided for nearly half its length, twice as broad at apex, a little longer than hind femur + trochanter. Second tergite hardly more than half the length of first, three times as long as apical width. First tergite little, second not contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Type. ♀, Brazil, Para (*Ducke*), 20 May '01 (V.). Paratype. ♀, British Guiana, Blairmont, Sept. '23, no. 42 (*F. X. Williams*) (W.).

T. cocorite sp. n.

Very closely allied to *T. fabricator* Smith and *T. moraballi* sp. n.

Female. Black, antennal segments 1–2 (more or less), mandibles, sides of segment 1, segments 2–3, reddish-pitchy. Pubescence silvery. Wings hyaline, darker at apex. Length 12 mm.

Resembles *T. fabricator* Sm., but vertex less dull, though very distinctly alutaceous, with very weak, irregular depressions. Ocelli separated by one-third their diameter from the eyes. Propodeum with dorsal area more convex, better defined, with deeper central impression, not crossed by any keels (as in *T. moraballi*). Posterior furrow not crossed by any keels or by a few very weak ones.

Type ♀ and paratype ♀, B.W.I., Trinidad, 13 May '33, no. 1934 (*D. Vesey FitzGerald*) (L.).

I had regarded this species as a small, dark variety of *T. moraballi* until Mr. FitzGerald showed me his Mss. notes on the nesting habits. These resemble rather those of *T. fabricator*, the female building tubular adjacent cells, attached to leaves (in *T. fabricator* more often attached to tree trunks, etc.).

T. moraballi sp. n.

Female. Black, antennae with base and apex of scape and apex of segment 2, mandibles, apex of clypeus, tegulae, narrow base to the tibiae and apical segment of fore tarsi, reddish. Abdomen red with first tergite dark brown. Wings hyaline. Pubescence silvery. Length 13 mm.

Occiput smooth and shining. Eyes a little closer at clypeus than on occiput where separated by about the length of antennal segment 3. Ocelli separated from eyes by one-third their diameter, by two-thirds diameter from one another. Vertex moderately shining with irregular, elongate impressions whose boundaries are completely rounded, central impression strong. Supraantennal keel somewhat raised bearing a blunt keel. Limiting keels of antennal scrobes forming an angulated transverse keel. Antennal sockets separated by two-thirds their diameter. Antennae with scape twice as long as greatest width, 3 five times as long as broad, somewhat longer than 4 + 5, 4 a little longer than 5, twice as long as broad, remaining segments all a little longer than broad, 12 one and a half times as long as 11. Clypeus with the centre of apical margin produced into a small rounded projection, the surface with dense outstanding silvery bristles. Occipital keel complete, horizontal space behind the buccal cavity narrow. Tempora beneath shining, unsculptured. Stipes of maxillae shining, unsculptured, the hairs at base dense. Proepisternal keel represented by a strong tooth at sides. Pronotum with centre scarcely and angles of collar strongly prominent, lateral tubercles produced into strong, triangular processes. Mesopleuron smooth, unsculptured. Pleural suture obsolete. Mesonotum and scutellum scarcely punctured, the latter convex. Metanotum convex, scarcely punctured, lateral lobes striate, posterior margin not hyaline, depressions large and deep. Area beneath metapleural keel weakly defined. Metasternum very narrowly emarginate. Propodeum with dorsal surface raised over a U-shaped but weakly defined area with a strong central longitudinal impression, crossed by obsolete striae. Posterior surface with a broad, shallow furrow, well defined above, extending to orifice where, however, it is so shallow as hardly to be recognisable, crossed by five or six fine keels, no keeled depression, orifice with dorsal margin produced into a projecting lobe, angles with no keels, without sculpture. Sides moderately defined above, smooth and shining. Fore coxae with strong bristles at apex. Hind coxae with no ventral tubercle. First abdominal tergite with no furrow, apophyses obsolete, spiracular area twice as long as broad, tergite at base narrower than length of hind trochanter, two and a half times wider at apex, longer than the hind femur + trochanter. Second tergite half the length of the first, nearly three times as long as broad. First distinctly, second not contracted at apex. Abdomen unusually elongate, somewhat compressed. Sixth tergite not keeled. Sternites apically pubescent.

Type. ♀, British Guiana, Essequibo R., Moraballi Creek, bred nest, 17 Oct. '29, no. 4371 O.U.Exped. Brit. Guiana (L.). Paratypes. 2 ♀♀, same locality, bred nest, 19 Sept. '29, no. 2284 O.U.Exped. Brit. Guiana (L.); ♀, Trinidad, 13 May '33 (*D. Vesey FitzGerald*); ♀, N. Brazil, Para Soure, Marajo (*O. Bertram*) (B.). In the last named ♀ the posterior furrow of the propodeum is not crossed by any keels.

var. **boliviense** var. n.

Female. Abdomen black, sides tergites 1–3, base 2–3 reddish. Ocelli separated by nearly two-thirds their diameter from eyes. Supraantennal keel less raised. Posterior furrow of propodeum not crossed by keels.

Type. ♀, Bolivia, Sta. Cruz (*H. Rolle*) (V.).

GROUP OF *T. FIGULUS* L.

Antennal sockets separated by from ¼ to ⅔ the diameter of a socket. Limiting keels of antennal scrobes forming a straight or angulated transverse keel or absent. Clypeus with the apical margin often produced into a small lobe or bearing two small teeth, with never more than sparse outstanding hairs, height from two-thirds to one and three-quarter times the least distance between the eyes below. Mandibles simple. Labrum often strongly bilobed but rarely with the lobes nearly as narrow and finger-shaped as in the group of *T. rufidens* Cam. Occipital keels usually complete or nearly complete, only widely interrupted in *T. staudingeri* sp. n., horizontal space behind the buccal cavity distinct though sometimes narrow. Lateral tubercles of pronotum weak and rounded (only stronger and sharp-edged in three species). Angles of pronotal collar rounded, not bordered. Proepisternal keel absent but the tubercle sometimes rather prominent. Prepectus with no dorsal furrow but with a transverse mesosternal keel (except in *T. caldesianum* sp. n. and *T. nigrispinis* Cam.). Mesopleural suture not developed except in *T. staudingeri* sp. n. Furrow in front of mid coxae never very strong, usually with weak crenations. Metapleural keel nearly straight, area not defined except in *T. caldesianum* sp. n. and *T. staudingeri* sp. n. Lateral lobes of postnotum black, not raised into lamellae. Furrow joining depressions in the metapleural-propodeal suture at least moderately strong, usually more or less crenate. Dorsal margin of orifice of propodeum sharp-edged, only strongly downcurved in *T. staudingeri* sp. n., orifice usually subcircular. Fore coxae without apical bristles in the female, dorsal keel never strong, ventral keel variable both in strength and direction. Mid coxae with the keel often only visible towards the apex. Hind coxae with inner dorsal keel usually removed from the edge of the coxa basally, coxa in female usually with a ventral pore, sometimes situated on a tubercle. Fore-wings with costa more or less distinctly produced beyond the radial cell, last section of M_{3+4} and im_1 set at an angle of 90–110°, last section of M_{1+2} 1½ to 4½, usually 2, times as long as the penultimate. Two groups of hamuli on the hind-wings consisting of 4–7 and 3–7 hooks each, the groups separated by ¾ to 3 (usually at least 1) times the length of the apical group. Sternites 2–5 more or less hairy, two or three bristles on each side of the apex of at least sternites 4 and 5, sometimes also of 2 and 3 (except *T. nigrellum* Rohw. which has only one a side). Eighth sternite (Pl. VI, figs. 8 and 11) of male with apical margin rounded or truncate. Male genitalia with stipes and squama quite distinct, volsellae variable, with or without a spine-like basal lobe, sagittae not very long, with or without a small ventral apical tooth (Pl. VIII, figs. 7–10).

Species usually small (but *T. ordinarium* sp. n. length 12·5 mm.) colour black (*T. sanctum* sp. n. paler) with at most the legs partly pale, wings nearly hyaline (these particulars of colour, etc., apply to the American species only). Cosmopolitan.

The following species, known to me only from their descriptions, probably belong to this group :—

T. chichemicum Saussure (1867, p. 83), Mexico.
T. toltecum Saussure (1867, p. 83), Mexico.
T. pennsylvanicum Saussure (1867, p. 82), Pennsylvania.
T. subfrigidum Rohwer (1909, p. 378), Texas.

T. fastigium Fox (1893, p. 476) = *T. carinifrons* Fox (1891, p. 142) *nec* Cameron, Texas.

T. regulare Viereck (1906, p. 205), Kansas.

All these species would appear to fall near *T. frigidum* Sm

The following non-American species also belong to the group of *T. figulus* L. in its widest sense. Doubtless in a world revision the group would have to be further subdivided.

T. albipes Sm., *T. annulatum* Cam., *T. attenuatum* Sm., *T. bicolor* Sm., *T. clavicerum* Lep., *T. coloratum* Sm., *T. elegantulum* Sm., *T. elongatum* Ashmd., *T. erythrozonatum* Cam., *T. eximium* Sm., *T. fletcheri* Turn., *T. formosicola* Strand, *T. geniculatum* Cam., *T. gracillimum* Sm., *T. hispanicum* Mercet, *T. hyperorientale* Strand, *T. intrudens* Sm., *T. mediator* Nurse, *T. melanocorne* Strand, *T. montanum* Schulz (= *placidum* Cam.), *T. nodosicorne* Turn., *T. obsonator* Sm., *T. ornatipes* Cameron *nec* Fox, *T. placidum* Sm., *T. providum* Sm., *T. simlaense* Cam., *T. stevensoni* Arnold, *T. testaceicorne* Cam., *T. testaceipes* Arnold, *T. trochanteratum* Cam., *T. varipilosum* Cam.

Probably the bulk of the non-American species which I have not been able to examine also belong here.

T. unicolor Palisot de Beauvois (1805, p. 116), S. Carolina, is unrecognisable. It may well belong to another genus, but if it is a species of *Trypoxylon* it probably belongs here.

T. nigrispinis Cameron (1905).

Female. Black, mandibles reddish. Margin of pronotal tubercles and tegulae pale. Wings hyaline, faintly fuscous at apex. Pubescence silvery. Length 6 mm.

Occiput dull, alutaceous. Eyes much closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by one-third their diameter from eyes, by one diameter from one another. Vertex finely coriaceous, central impression nearly obsolete. Supraantennal keel not raised, represented by a short fine keel. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by nearly half their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 nearly three times as long as broad, much shorter than 4 + 5, 4 and 5 subequal, rather more than twice as long as broad, remaining segments all longer than broad, 12 two and a half times as long as broad, one and a half times as long as 11. Clypeus with margin produced into a small, central, trapezoidal lobe. Occipital keel complete, horizontal space behind the buccal cavity very narrow, as broad as width of last segment of maxillary palpi. Tempora beneath a little shining, finely alutaceous, very finely punctured. Stipes of maxillae shining, finely alutaceous. Proepisternal tubercle not prominent. Lateral tubercles of pronotum subobsolete. Prepectus with no mesosternal keel. Mesopleuron moderately shining, finely alutaceous, unpunctured. Mesonotum and scutellum dull, finely coriaceous, the latter flat. Metanotum nearly flat, alutaceous, lateral lobes striate, posterior margin not hyaline, depressions deep and narrow. Metasternum not emarginate. Propodeum with dorsal surface not defined, no distinct central impression, surface finely but rather irregularly striate. Posterior surface with a shallow furrow, hardly defined above, ending at half its length from orifice, keeled depression weakly defined, longitudinally bisected, the halves subcircular, orifice with dorsal margin a little downcurved, angles with no keels, finely striate. Sides weakly defined above, finely and regularly striate. Hind coxa with no ventral organ. First abdominal tergite with no furrow, spiracular area strongly transverse, apophyses obsolete, tergite at base rather wider than length of hind trochanter, one and a half times as wide at apex, as long as hind femur + trochanter. Second tergite three-quarters as long as first, one and a third times as long as apical width. First and second tergites very little contracted at apex. Sixth tergite unkeeled. Apical sternites pubescent.

Specimens examined: Type. ♀, Mexico, Cameron coll. (L.).

T. ordinarium sp. n.

Female. Black, mandibles and tegulae pitchy. Wings hyaline, darker at apex. Pubescence silvery. Length 12·5 mm.

Occiput alutaceous, finely punctured. Eyes about equally separated at clypeus and on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by half their diameter from eyes, by one diameter from one another. Vertex dull, finely coriaceous, with numerous shallow, flat-bottomed punctures, central impression shallow. Supraantennal keel moderately raised, bearing a fine keel. Limiting keels of antennal scrobes forming a straight transverse keel. Antennal sockets separated by two-thirds their diameter. Antennae with scape twice as long as greatest width, 3 three times as long as broad, only a little longer than 4, 4 a little longer than 5 which is two and a half times as long as broad, remaining segments progressively shorter, penultimate ones nearly quadrate, 12 two and a half times as long as broad, nearly twice as long as 11. Clypeus with apical part polished, centre of margin with a small, weakly emarginate, central projection: between this and base of mandibles the margin is distinctly sinuate. Occipital keel complete, crenulate, horizontal space behind buccal cavity rather broad, broader than width of fore basitarsus. Tempora beneath rather dull, finely alutaceous. Stipes of maxillae alutaceous, dull. Proepisternal tubercle rather prominent, bearing a tuft of white pubescence. Lateral tubercles of pronotum very weak. Mesopleuron rather dull, alutaceous, finely and rather closely punctured. Mesonotum dull, alutaceous, finely and very closely punctured. Scutellum more sparsely punctured, flat. Metanotum flat, lateral lobes striate, posterior margin not hyaline, depressions large and deep. Metasternum very narrowly emarginate. Propodeum with dorsal area not defined, a weak central impression across which the striae are transverse, the remainder of the surface with diagonal striae continuous with those of sides. Posterior surface with a deep, narrow furrow, well defined above, crossed at half its length from orifice by three fine striae the lowest of which is the dorsal margin of the keeled depression which is strongly defined laterally and bisected in its lower half by a fine, longitudinal keel, orifice with its dorsal margin a little downcurved, angles with short but strong keels and regular striae. Sides weakly defined above, moderately shining, with fine regular striae. Hind coxa with a moderately large, dull, pubescent patch, not quite on inner edge of ventral surface and situated rather nearer base than apex. First abdominal tergite with a strong furrow for half its length, spiracular area three-quarters as long as broad, apophyses strong but rounded, tergite at base a little wider than length of hind trochanter, two and a half times as broad at apex, as long as hind femur + trochanter. Second tergite a little longer than half first, one and a half times as long as apical width. First tergite strongly, second little contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Type. ♀, Brazil (*Winthem*) (V.).

T. bidentatum Fox (1891).

Female. Black, fore legs and tegulae somewhat paler. Mandibles reddish at base. Wings hyaline. Pubescence silvery. Length 7·5 mm.

Occiput dull, finely alutaceous. Eyes distinctly closer together at clypeus than on occiput where separated by a distance rather more than equal to length of antennal segments 2 + 3. Ocelli separated by a little more than one-third their diameter from eyes, by one and a half diameters from one another. Vertex dull, coriaceous, central impression nearly obsolete. Supraantennal keel rather strongly raised bearing a fine keel, as long as scape. Limiting keels of antennal scrobes forming a fine, straight, transverse keel, a little produced forwards in centre. Antennal sockets separated by less than one-quarter their diameter. Antennae with scape one and two-thirds times as long as greatest width, 3 three times as long as broad, much shorter than 4 + 5, 4 a little longer than 5 which is two and a third times as long as 4, remaining segments all at least a little longer than broad, 12 two and a half times as long as broad, as long as 10 + 11. Clypeus with apical margin polished, evenly rounded, with centre produced into a small, subrectangular lamella whose apex is weakly emarginate. Occipital keel nearly complete, horizontal space behind the buccal cavity rather narrow, twice as broad as apical segment of maxillary palpi. Tempora beneath rather dull, coriaceous rather than punctured. Stipes of maxillae smooth and shining. Proepisternal tubercle not prominent. Lateral tubercles of pronotum weak and rounded. Mesopleuron rather dull, rather closely but finely and shallowly punctured. Mesonotum dull, alutaceous, finely and closely punctured. Scutellum similar but more shining, flat. Metanotum nearly flat, finely alutaceous, lateral lobes striate, posterior margin not hyaline, depressions deep. Metasternum with a narrow emargination. Propodeum with dorsal area not defined, with a feeble central impression, surface with weak, irregular striae which tend to be arranged longitudinally. Posterior surface with a rather shallow furrow, moderately well defined above, almost disappearing before the marked keeled depression, orifice with dorsal margin hardly downcurved, angles with very short keels, surface granulate. Sides moderately well defined above, finely striate. Hind coxa ventrally with a small depression, bearing a tuft of hairs, on inner edge half-way between base and apex. First abdominal tergite with a furrow for half its length, spiracular area hardly longer than broad, apophyses distinct but rounded, tergite at base as wide as length of hind trochanter, gradually dilated to apex where it is two and a half times as wide, rather longer than hind femur + trochanter. Second tergite a little longer than half first, one and a half times as long as apical width. First distinctly, second hardly contracted at apex. Sixth tergite keeled for half its length. Apical sternites pubescent.

Specimens examined: ♀, U.S.A., New York State, Ithaca, 30 May '95 (J. C. Bradley det.) (L.).

T. apicale Fox (1891).

Female. Black, last segment of fore tarsi and tegulae reddish. Wings hyaline, a little darker towards apex. Pubescence silvery. Length 8·5 mm.

Occiput rather dull, very finely coriaceous. Eyes distinctly closer together at clypeus than on occiput where separated by a distance equal to a little more than length of antennal segments 2 + 3. Ocelli separated by half their diameter from eyes, by a little more than their diameter from one another. Vertex dull, finely coriaceous, central impression fine but distinct. Supraantennal keel strongly raised, bearing a fine keel which ends posteriorly at a point one-third of the way from upper edge of sockets to median ocellus. Limiting keels of antennal scrobes forming a straight transverse keel. Antennal sockets separated by half their diameter. Antennae with scape twice as long as greatest width, 3 two and a half times as long as broad, much shorter than 4 + 5, 4 a little longer than 5 which is about twice as long as broad, remaining segments progressively shorter, 12 a little longer than twice as long as broad, as long as 10 + 11. Clypeus with apical margin polished, evenly rounded with moderately, central, large trapezoidal projection which is slightly emarginate. Occipital keel nearly complete, horizontal space behind the buccal cavity rather broad. Tempora beneath moderately shining, closely and very finely punctured. Stipes of maxillae smooth and shining. Proepisternal tubercle not prominent. Lateral tubercles of pronotum weak and rounded. Mesopleuron moderately shining, alutaceous, finely and very sparsely punctured. Mesonotum and scutellum absolutely dull, alutaceous, with moderately close, exceedingly fine punctures, the scutellum flat. Metanotum flat, lateral lobes striate, posterior margin not hyaline, depressions deep. Metapleuron very shining compared with mesopleuron or sides of propodeum. Metasternum with a very narrow emargination. Propodeum with dorsal area not defined, with a distinct central impression which is smooth and shining, surface outside this with irregular, fine striae which radiate outwards and backwards. Posterior surface with a deep furrow, well defined above, extending to the distinct keeled depression, orifice with dorsal margin hardly downcurved, angles with no keels, with weak irregular striae. Sides well defined above, rather dull, with fine striae. Hind coxa ventrally with a dull, pubescent patch on inner edge mid way between base and apex. First abdominal tergite with a rather strong furrow for half its length, spiracular area hardly longer than broad, apophyses weak, tergite at base as wide as length of hind trochanter, parallel-sided for two-thirds of its length then suddenly expanding to apex where it is twice as broad, as long as hind femur + trochanter + coxa. Second tergite less than half as long as first, one and a half times as long as apical width. First tergite little, second hardly contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Specimens examined: ♀, U.S.A., Illinois, coll. Saussure (G.). This specimen was received as a " type " of *T. toltecum* Sauss., but it does not agree with the original description nor does the label indicate the type locality. Whether it is really the same as *T. apicale* of Fox is also doubtful; it certainly runs down to that species in the key given by Rohwer (1909). Some remarks on the taxonomy of allied species will be found in the account of *T. frigidum* Sm.

T. frigidum Smith (1856).

Very close to *T. bidentatum* Fox, but differs as follows:—Size perhaps a little larger, length about 8·5 mm.

Eyes hardly more separated at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated from eyes by a variable distance, from a little less than one-half to two-thirds their diameter, from one another by from one and a third to one and a half diameters. Supraantennal keel hardly raised, bearing an obtuse keel. Dorsal surface of propodeum with no distinct depression, with a central longitudinal keel and numerous other irregular, more or less longitudinal keels. Posterior surface with keeled depression often longitudinally bisected. Hind coxae with a small dull, pubescent patch not quite on inner edge rather nearer base than apex.

Male. Eyes closer at clypeus. Antennae with scape one and a half times as long as greatest width, 3 two and a third times as long as broad, hardly longer than 4, 4 and 5 subequal, twice as long as broad, remaining segments progressively shorter and thicker, penultimate ones quadrate, 13 two and a half times longer than broad, longer than 11 + 12. Hind coxa and seventh tergite simple.

Specimens examined: Type. ♀, Canada, Hudson Bay (L.) (now headless and with the head of a Sphecoid of another family gummed on). Other specimens: ♀, Canada, Hudson Bay (L.). *U.S.A.:* ♂, New York, Trenton Falls (*R. Foster*) (L.); ♂, Ithaca, 19 June '90 (det. J. C. Bradley) (L.); ♂, 2 ♀♀, Ithaca, June–July '23 (*Maidl*) (V.); ♀, Iowa (recd. from D. Elden Beck); ♂♀, Carolina (*Zimmermann*) (B.); ♂♀, Colorado, Florissant, 23 June '07 and 12 June '08 (*S. A. Rohwer*) (L.); ♀, " White Mount " (*Morrison*) (B.).

T. frigidum Sm. is very closely allied to the European *T. figulus* L., from which it differs as follows: Thorax a little duller and less closely punctured, dorsal area of propodeum with no distinct depression, first abdominal tergite relatively narrower.

This whole group of small black species requires much more study. Some of the characters appear to be unusually variable, and it is by no means certain that I have separated them correctly. What is required is a long series of specimens from all parts of U.S.A. and particularly series bred from nests, so that the limits of variation within the species can be more definitely determined.

T. morrisoni sp. n.

Very close to *T. bidentatum* Fox, but differs as follows:—Size perhaps a little larger, length 8·5 mm.

Eyes separated at clypeus by two-thirds what they are on occiput where separated by a distance nearly equal to length of antennal segments 2 + 3 + 4. Supraantennal keel not raised, bearing a fine keel as long as scape. Antennae with segments shorter, as in *T. apicale* Fox. Horizontal space behind the buccal cavity about as broad as width of fore basitarsus. Tempora beneath shining, scarcely sculptured. Mesopleuron more shining, lower part faintly alutaceous, sparsely and finely punctured, upper part smooth, almost unsculptured. Scutellum shining. Propodeum with dorsal surface with a more distinct central impression, striae diagonal at base, more transverse at apex but nearly obsolete on apical third. Posterior surface with keels of angles stronger, subtending an area one and a half times as broad as high. Hind coxa ventrally with a moderately large, oval, pubescent patch almost on inner edge, nearer apex than base. Second abdominal tergite nearly two-thirds as long as first, two and a third times as long as apical width. Sixth tergite not keeled.

Type. ♀, Nevada (*Morrison*) (B.).

T. plesium Rohwer (1920).

Female. Black, mandibles piceous; tegulae testaceous. Wings hyaline. Pubescence silvery. Length 8·5 mm.

Occiput moderately shining, finely alutaceous. Eyes equally separated at clypeus and on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by one-third their diameter from eyes, by one diameter from one another. Vertex dull, finely coriaceous, central impression weak. Supraantennal keel hardly prominent, bearing a fine keel as long as scape. Limiting keels of antennal scrobes forming a transverse, obtusely angulated keel. Antennal sockets separated by one-third their diameter. Antennae with scape not quite as long as twice greatest width, 3 three times as long as broad, much shorter than 4 + 5, 4 hardly longer than 5 which is two and a half times as long as broad, remaining segments all longer than broad, 12 two and a half times as long as broad, one and a half times as long as 11. Clypeus with apical margin polished, with a rounded central projection covering one-quarter of width of margin. Occipital keel nearly complete, horizontal space behind buccal cavity narrow, as broad as two-thirds basal width of third antennal segment. Tempora beneath dull, alutaceous. Stipes of maxillae shining, faintly alutaceous. Proepisternal tubercle not prominent. Lateral tubercles of pronotum rounded but rather stronger than in related species. Mesopleuron dull, alutaceous, on upper half not punctured, on lower part with very weak, moderately close punctures. Mesonotum and scutellum dull, alutaceous, with traces of very fine punctures, the latter flat. Metanotum a little convex, dull, lateral lobes with posterior margin not hyaline, depressions deep and rather large. Propodeum with dorsal surface not at all defined, central depression obsolete, surface irregularly rugose, moderately shining. Posterior surface with a deep furrow, moderately well defined above, ending below in a large keeled depression which is bisected by a strong central keel, the two halves so formed quadrate, orifice with dorsal margin a little downcurved, angles with no keels, finely rugose with two or three irregular striae on lower half. Sides well defined above, shining, finely striate. Hind coxa considerably swollen and reddish ventrally half-way between base and apex and here with a small oval, dull patch on inner edge. First abdominal tergite with a furrow for half its length, spiracular area a little longer than broad, apophyses obsolete, tergite at base as wide as length of hind trochanter, two and a half times as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a third times as long as apical width. First tergite rather strongly, second little contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Male. Ocelli separated by half their diameter from eyes. Antennae with 3 hardly three times as long as broad, 5 only twice as long as broad, penultimate segments just transverse, 13 two and a half times as long as broad, as long as 11 + 12. Clypeal projection smaller. Hind coxa simple. Seventh tergite weakly emarginate at apex.

Specimens examined: ♀, paratype, U.S.A., N. Illinois, no. 21611 (W.); ♂, Maryland, Glen Echo, 31 July '17 (*R. M. Fouts*) (W.); ♀, Utah, Uintah Mts., Tyrol Lake (*T. Swallow*) (recd. from D. Elden Beck).

In the last named female the ocelli area separated by two-thirds their diameter from eyes; but I cannot at present associate the specimen with any other species.

T. nigrellum Rohwer (1909*a*).

Female. Black, mandibles and tegulae paler. Wings hyaline. Pubescence silvery. Length 6·5 mm.

Occiput shining, faintly alutaceous. Eyes distinctly closer at clypeus than occiput where separated by a distance equal to length of antennal segments 3 + 4 + half of 2. Ocelli separated by one-third their diameter from eyes, by one and a third diameters from one another. Vertex dull, densely alutaceous, with hardly traceable punctures, central impression weak. Supraantennal keel moderately prominent, bearing a keel as long as scape. Limiting keels of antennal scrobes forming a short, straight, transverse keel, emitting a small one between sockets above. Antennal sockets separated by hardly more than half their diameter. Antennae with scape twice as long as greatest width, 3 twice as long as broad, hardly longer than one and a half times 4, 4 and 5 subequal, one and two-thirds times as long as broad, remaining segments progressively shorter, 9–11 quadrate, 12 twice as long as broad, as long as 10 + 11. Clypeus with apical margin polished and a little upturned, evenly rounded with a small, trapezoidal projection covering one-fifth of width. Occipital keel not quite complete, horizontal space behind buccal cavity narrow, twice as wide as width of apical maxillary palpal segment. Tempora beneath moderately shining, faintly alutaceous. Stipes of maxillae smooth and shining. Proepisternal tubercle not prominent. Lateral tubercles of pronotum nearly obsolete. Mesopleuron moderately shining, faintly alutaceous, sparsely but rather strongly punctured. Mesonotum and scutellum moderately shining, faintly alutaceous sparsely and rather finely punctured, the latter flat. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions not large or deep. Metasternum not emarginate. Propodeum with dorsal area defined by a moderately distinct U-shaped furrow, with a shallow central impression, basal quarter sloping up towards metanotum, this part longitudinally striate, the rest of surface with rather numerous and strong transverse striae. Posterior surface with a deep furrow, well defined above, flattening out before the orifice, no keeled depression, orifice with dorsal margin hardly downcurved, angles with no keels, coarsely rugose, becoming striate on upper half. Sides sharply defined above, shining, finely striate. Hind coxa with no ventral organ. First abdominal tergite with a furrow for half its length, spiracular area a little longer than broad, apophyses obsolete, tergite at base nearly as broad as length of hind trochanter, one and three-quarter times as broad at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, twice as long as apical width. First tergite hardly, second not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Specimens examined: ♀, U.S.A. Texas, Brownsville, 16 Jan. '23 (*T. C. Barber*) (Rohwer det.) (W.).

T. caldesianum sp. n.

Female. Black, mandibles, fore tibiae except for dorsal streak, pale yellow. Fore tarsi, apex of mid tibiae, base of mid tarsi, pale yellow-brown. Wings hyaline. Pubescence silvery. Length 7 mm.

Occiput moderately shining, weakly alutaceous. Eyes unusually close together both at clypeus and on occiput, at the former point distinctly closer together than on occiput where separated by a distance about equal to length of antennal segments 2 + 3. Ocelli separated by one-quarter their diameter from eyes, by two-thirds of a diameter from one another. Vertex dull, finely coriaceous, central impression distinct and rather narrow. Supraantennal keel not developed but whole vertex raised towards a central point just above the antennae. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by rather less than half their diameter. Antennae with scape one and two-thirds times as long as their greatest width, 3 twice as long as broad (a little shorter than scape), shorter than 4 + 5 which are both a little longer than broad, remaining segments progressively short and thicker, penultimate ones quadrate, 12 nearly twice as long as broad, as long as 10 + 11. Clypeus with apical margin not shining, with two small central teeth. Occipital keel complete, horizontal space behind the buccal cavity moderately broad. Tempora beneath smooth and shining. Stipes of maxillae shining, weakly alutaceous. Proepisternal tubercle a little angular. Lateral tubercles of pronotum very weak. Prepectus with no mesosternal keel. Mesopleuron finely punctured and alutaceous and not very shining below, strongly shining on upper half, scarcely punctured. Mesonotum and scutellum dull, with very fine and close punctures, the scutellum flat. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions moderately large. Area beneath the metapleural keel defined. Metasternum invisible. Propodeum with dorsal area rather well defined by a U-shaped furrow, central impression just indicated, surface finely and regularly striate, striae diagonal at base, more transverse at apex (more irregular outside area). Posterior surface with a shallow furrow, well defined above, extending to orifice, no keeled depression, orifice with dorsal margin a little downcurved, angles with no keels, finely striate. Sides well defined above, somewhat shining, with very fine, subobsolete striae. Hind coxae with no ventral organ. First abdominal tergite with no furrow, spiracular area twice as long as broad, apophyses obsolete, tergite at base a little narrower than length of hind trochanter, twice as wide at apex, nearly as long as hind femur + trochanter + coxa. Second tergite a little longer than half first, two and a half times as long as apical width. First tergite moderately, second hardly contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Male. Mid tibiae pale beneath. Antennae with scape twice as long as greatest width, 3 twice as long as broad, nearly as long as 4 + 5, 4 a little shorter than 5 which is about quadrate, 6 one and two-thirds times as long as broad, 6–10 progressively shorter, 10 just transverse, 11–13 considerably wider, almost forming a club, 11–12 transverse, 13 twice as long as broad, a little longer than 11 + 12. Clypeus with a central lobe covering a third of its apical width. Dorsal area of propodeum less clearly defined. Sternites 2–5 of abdomen entirely hidden by the strongly deflexed tergites, except the apex of 5 which is foveate and centrally nicked.

Type. ♀, Colombia, Caldes, '16 (*M. T. Dawe*) (L.). Allotype. ♂, Costa Rica, Turrialba, April '21 (*Heyne*) (B.). Paratype. Another male with the same data.

T. ecuadorium sp. n.

Female. Black. Wings a little infuscate. Pubescence silvery, outstanding on head and thorax. Length 11 mm.

Occiput finely alutaceous. Eyes much closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by two-thirds their diameter from eyes, by one diameter from one another. Vertex dull, strongly alutaceous, central impression obsolete. Supraantennal keel moderately raised bearing a very fine keel. Limiting keels of antennal scrobes forming a nearly straight, bisinuate transverse keel. Antennal sockets separated by half their diameter. Antennae with scape twice as long as greatest width, 3 three and a half times as long as broad, much shorter than 4 + 5, 4 hardly longer than 5 which is two and a third times as long as broad, remaining segments progressively shorter, penultimate ones quadrate, 12 two and a half times as long as broad, twice as long as 11. Clypeus transversely impressed before apex and after this somewhat upturned, with a broad, trapezoidal lobe in centre. Occipital keel complete, horizontal space behind the buccal cavity wide, as wide as apical width of fore tibia. Tempora beneath dull, alutaceous. Stipes of maxillae finely alutaceous. Proepisternal keel just indicated as a transverse prominence behind the rather convex tubercle. Pronotum with lateral tubercles rather prominent, subtriangular. Mesopleuron dull, subcoriaceous, sparsely and finely punctured. Mesonotum dull, coriaceous. Scutellum dull and coriaceous, sparsely punctured, flat. Metanotum flat, on same level as scutellum, lateral lobes striate, posterior margin not hyaline, depressions deep, pyriform. Metasternum with a very narrow emargination. Propodeum (fig. 20) with dorsal surface defined by the nature of the sculpture but hardly by a furrow, somewhat raised into weak tubercles on each side of top of posterior furrow, central impression shallow and widening posteriorly, surface with regular, longitudinal striate and transverse ones across the impression. Posterior surface with a deep furrow, well defined above, shallowing out before the orifice, no keeled depression, orifice with dorsal margin a little downcurved, angles with short keels, with fine striae. Sides well defined above, with fine, regular striae. Hind coxa with a small ventral tubercle. First abdominal tergite with no furrow, apophyses distinct, tergite at base as wide as length of hind trochanter, one and a half times as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, one and a half times as long as apical width. First tergite strongly, second a little contracted at apex. Sixth tergite keeled on apical half. Apical sternites pubescent.

Male. Ocelli separated by one and a half times their diameter from eyes, by the same distance from one another. Supraantennal keel weaker. Antennae with scape one and two-thirds times as long as greatest width, 3 two and a quarter times as long as broad, much shorter than 4 + 5, 4 and 5 twice as long as broad, 6–12 progressively shorter, 10–12 just transverse, 13 three and a half times as long as broad, a little longer than 10 + 11 + 12. Clypeus with produced part of apical margin smaller and narrower. Proepisternum with no keel, tubercle angularly prominent. Seventh tergite simple.

Type. ♀, Ecuador, Province of Loja, 2220 m. (*Prof. C. Carrión*) (L.) (nesting in wood). Allotype. ♂, Colombia, Bogota (*Lindig*) (B.). *T. bourgeosi* Strand (1911, p. 155), Ecuador, may be an earlier name for this species.

var. **meridionale** var. n.

Length 9 mm.

Ocelli separated by one-third their diameter from eyes, by one and a half diameters from one another. Vertex and mesonotum with sparse though distinct punctures besides the alutaceous sculpture. Limiting keels of antennal scrobes sharply angled.

Type. ♀, Colombia, Vista Nieve, San Lorenzo Mts., 20 Dec. '22 (W.). Paratypes. 2 ♀♀, the same place, 18 and 19 Dec. '22 (W.).

T. sanctum sp. n.

Female. Black, antennae with apex of scape and underside of segment 2, apex of clypeus, mandibles, margin of pronotal tubercles, tegulae, narrow apex of all coxae, all trochanters, narrow base and apex of all femora, fore tibiae except a narrow streak beneath, fore tarsi, base and apex of mid tibiae, mid tarsi, basal quarter of hind tibiae, annulations of hind tarsi, yellowish-brown. Narrow apex and sides of first abdominal tergite, whole of second and third, except an apico-discal patch, reddish-testaceous. Wings hyaline. Pubescence silvery. Length 10·5 mm.

Occiput shining, hardly punctured. Eyes hardly separated at clypeus by half as much as they are on occiput where separated by a distance equal to length of antennal segments 3 + half of 2. Ocelli separated by one-third their diameter from eyes, by nearly one diameter from one another. Vertex dull, alutaceous, finely and closely punctured, central impression distinct. Supraantennal keel moderately raised, bearing a fine keel. Limiting keels of antennal scrobes obsolete. Antennal sockets separated by less than half their diameter, their dorsal edge rather strongly raised. Antennae with scape twice as long as greatest width, 3 five times as long as broad, nearly as long as 4 + 5, 4 a little longer than 5 which is three times as long as broad, remaining segments progressively shorter, penultimate ones hardly longer than broad, 12 twice as long as broad, nearly as long as 10 + 11. Clypeus with central third of apical margin produced into a slightly prominent lamella. Occipital keel complete, horizontal space behind the buccal cavity broad, broader than width of fore basitarsus. Tempora beneath shining, finely and very sparsely punctured. Stipes of maxillae smooth and shining. Proepisternal tubercle not prominent. Lateral tubercles of pronotum prominent, subtriangular but rounded. Mesopleuron very shining, very sparsely and finely punctured. Mesonotum moderately shining, feebly alutaceous, finely and moderately closely punctured. Scutellum more shining, less closely punctured, flat. Metanotum flat, lateral lobes striate, posterior margin not hyaline, depressions shallow. Metasternum not emarginate. Propodeum with dorsal surface sharply defined by a regularly crenate, U-shaped furrow, with a well-defined though shallow central impression and a regularly and largely crenate transverse furrow at base, central impression transversely striate, surface otherwise shining, sparsely and obsoletely punctured. Posterior surface with a deep, narrow furrow, sharply defined above, shallowing out before the orifice and crossed below by two or three fine striae, no distinct keeled depression, orifice with dorsal margin produced into a distinct lobe, angles with rather strong, inward-curving keels, surface regularly and rather coarsely striate. Sides sharply defined above, shining, finely and rather closely punctured with traces of striae, only a narrow anterior strip completely smooth. Hind coxa with an angular tubercle on inner ventral edge just before apex. First abdominal tergite with no furrow, spiracular area twice as long as broad, apophyses strong, subangular, tergite at base a little narrower than length of hind trochanter, parallel-sided for two-thirds of its length, nearly three times as wide at apex, rather longer than hind femur + trochanter + coxa. Second tergite one-third the length of first, a little longer than apical width. First tergite little, second not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Male. Length 10 mm.

Eyes separated on occiput by a distance equal to length of antennal segments 2 + 3 + 4. Ocelli separated by nearly half their diameter from eyes. Vertex finely coriaceous, rather more shining and more strongly punctured. Antennae with scape one and two-thirds times as long as greatest width, 3 two and a half times as long as broad, shorter than 4 + 5, 4 and 5 one and a half times as long as broad, remaining segments progressively shorter, 9 quadrate, 10–12 transverse, 13 about four times as long as broad, nearly as long as 9 + 10 + 11 + 12. Proepisternal tubercles more prominent. Hind coxa without tubercle. First abdominal tergite with a furrow for half its length, apophyses weaker, tergite at base hardly wider than half the length of hind trochanters, three and a half times as wide at apex, much longer than hind femur + trochanter + coxa. Seventh tergite simple.

Type. ♀, Brazil, Santos (*Dr. Brauns*) (V.). Paratypes. Another female with same data; ♀, Brazil (*Lhotzky*) (B.); 2 ♀♀, Brazil, Ceara, '31 (*Diaz de Roche*) (W.). Allotype. ♂, Brazil, Uberaba (*Draenert*) (V.).

This species forms a transition to the group of *T. fabricator* Sm., but it is convenient to deal with it in its present position where the character of the lateral lobe of the postnotum would naturally place it.

T. staudingeri sp. n.

Female. Black, apex of clypeus, mandibles, tegulae, margin of pronotal tubercles indeterminately, narrow apex of four front femora, fore tibiae except a postero-dorsal streak, fore tarsi except a dark dorsal mark on first three segments, narrow base and apex of mid tibiae, very narrow annulations of four hind tarsi, pale yellow-brown. Wings hyaline. Pubescence silvery. Length 10 mm.

Occiput dull, very finely coriaceous. Eyes distinctly closer at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4. Ocelli separated by nearly two-thirds their diameter from eyes, by one and a third diameters from one another. Vertex dull, coriaceous, with a weak central impression. Supraantennal keel in the form of a fine keel as long as scape. Limiting keels of antennal scrobes forming a straight transverse keel from which on each side a minute keel joins it to upper edge of sockets, thus defining a small, triangular depression. Antennal sockets separated by one-third their diameter from eyes, by one and a third diameters from one another, upper edge a little raised. Antennae with scape nearly twice as long as greatest width, 3 three times as long as broad, much shorter than 4 + 5, 4 and 5 hardly twice as long as broad, remaining segments progressively a little shorter but all longer than broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus with apical margin rounded, a little upturned. Occipital keel high but widely interrupted, horizontal space behind buccal cavity very broad, one and a half times as broad as width of fore tibiae. Tempora beneath shining, feebly granulate. Stipes of maxillae similar in sculpture. Proepisternal tubercle rather strongly prominent. Pronotum strongly prominent in centre, moderately at sides, lateral tubercles rather sharp-edged. Mesopleuron shining, below finely and closely punctured, above smooth. Pleural suture extending half-way up the pleuron. Mesonotum weakly alutaceous, rather dull, very closely and moderately strongly punctured. Scutellum similar but more shining, flat. Metanotum flat, finely and closely punctured, lateral lobes with one strong stria, posterior margin not hyaline, depressions pyriform, moderately deep. Area beneath metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal surface moderately well defined by a U-shaped furrow, no central impression, striae strong, diagonal at base, weaker and more transverse at apex. Posterior surface with a furrow which is broad above and deeper and narrower below, well defined above, crossed below by one stria, keeled depression moderately well-defined, bisected by a fine central stria, each half one and two-thirds times as high as broad, orifice with dorsal margin considerably down-curved, angles with no keels, surface weakly rugose with some strong transverse striae. Sides well defined above, shining, very obsoletely striate, more distinctly on upper quarter and posteriorly, a fine keel curving up in front of hind coxae. Hind coxa with a small, sharp tubercle on inner ventral edge near apex. First abdominal tergite with a short furrow, spiracular area one and a half times as long as broad, apophyses moderately strong but rounded, tergite at base, as wide as length of hind trochanter, two and a quarter times as wide at apex, nearly as long as hind femur + trochanter + coxa. Second tergite rather longer than half the first, two and a half times as long as apical width. First tergite strongly, second hardly contracted at apex. Sixth tergite keeled on its apical half. Apical sternites with only very small apical patches of pubescence.

Type. ♀, Peru, Villoanota (*Staudinger*) (B.). Paratype. ♀, Peru (V.).

GROUP OF *T. RUFIDENS* CAM.

Antennal sockets separated by ¼ to ½ the diameter of a socket. Limiting keels (fig. 5) of the antennal scrobes parallel, joining one another in a continuous curve just above the antennae; the area so defined falls vertically on to the face below. Clypeus with apical margin more or less thickened and emarginate, with practically no outstanding hairs except right at apex, height one and a half times greater than least width between the eyes below. Mandibles in the female short and broad, strongly bidentate, simple in the male. Labrum in the female (fig. 57) produced into finger-shaped processes which pass through small emarginations in the thickened apex of the clypeus. Occipital keels not quite complete horizontal space behind buccal cavity unusually broad. Lateral tubercles of pronotum very weak or obsolete. Angles of pronotal collar rounded, not bordered. Proepisternal keel at most represented by a small tooth at the sides. Prepectus with no dorsal or ventral furrows. Mesopleural suture not developed. Furrow in front of mid coxae very weak. Metapleural keel moderately curved (intermediate), area defined. Lateral lobes of postnotum black, not raised into lamellae. Furrow joining depressions in metapleural-propodeal suture usually strong and crenate. Dorsal margin of orifice of propodeum distinctly downcurved, orifice small and circular. Fore coxae without apical bristles in the female, keels variable in strength, parallel to one another. Mid coxae with keel very obtuse. Hind coxae with a weak inner dorsal keel along edge of coxae; no ventral tubercle in the female. Fore-wings with the costa distinctly produced beyond the radial cell, last section of M_{3+4} and im_1 set at an angle of 90° which is usually completely rounded, last section of M_{1+2} about twice the length of the penultimate. Two groups of hamuli on the hind-wings consisting of 4–5 and 3 hooks each, the groups separated by about twice the length of the apical row. Sternites 2–5 hairy, with one bristle on the first two and two on the two last sternites on each side. Junction of abdominal tergites strongly incised dorsally in the female. Eighth sternite of male with posterior margin rounded and bearing a long fan of hairs. Male genitalia very minute, stipes and squama not distinct; volsellae finger-shaped, two-thirds as long as sagittae, fused for most of their length, with a spine-like basal lobe; sagittae narrow, parallel-sided, hardly downcurved at apex, where they bear a small lateral tooth.

Species small (length 7 mm. or less), black with at most legs partly pale, wings hyaline; the quadrate head and unusually elongate thorax and propodeum give the species a distinctive appearance. The group is found from Mexico to the Argentine.

T. rufidens Cameron (1905).

Female. Black, narrow posterior margin of pronotum and pronotal tubercles pale. Wings very weakly infuscate. Pubescence silvery. Length 7·5 mm.

Occiput finely coriaceous. Eyes distinctly closer at clypeus than on occiput where separated by a distance equal to length of antennal segments 3 + 4 + 5. Ocelli separated by hardly more than half their diameter from eyes, by one and a half times their diameter from one another; the posterior margin of the hind ocelli separated from occipital keel by one and two-thirds times the distance between their outer edges. Vertex dull, finely coriaceous. Supraantennal keel and limiting keels of antennal scrobes replaced by a flat raised area defined laterally by straight keels parallel to one another, the area rounded anteriorly and one and a half times as long as broad, the lateral keels ending at a point almost on a level with middle of eye-emargination. Antennal sockets separated by one-third their diameter.

Antennae with scape one and a half times as long as greatest width, 3 one and two-thirds times as long as broad, much shorter than 4 + 5, 4 and 5 subequal one and a quarter times as long as broad, remaining segments very similar in length but becoming thicker, 12 twice as long as broad, one and a half times as long as 11. Clypeus with apical margin broadly and shallowly emarginate, with centre thickened and truncate, the truncate area higher than broad. Mandibles short and broad, bidentate, the lower tooth the larger. Occipital keel not quite complete, horizontal space behind the buccal cavity unusually broad, as broad as greatest width of fore femora. Tempora beneath finely coriaceous. Stipes of maxillae moderately shining. Buccal cavity unusually small. Proepisternal keel represented merely by a small tooth at sides. Pronotum rather deeply impressed in centre. Mesopleuron dull, finely coriaceous. Mesonotum and scutellum dull, finely coriaceous, the latter flat. Metanotum flat, lateral lobes striate, posterior margin not hyaline, depressions shallow. Metasternum with a very small emargination. Propodeum with dorsal surface fully twice as long as broad, not defined, raised up to level of metanotum where they are contiguous, centre basally with a fine keel, surface rather finely and irregularly striate, striae diagonal on anterior third and transverse posteriorly. Posterior surface with a very shallow furrow, no keeled depression, orifice with dorsal margin rather broadly downcurved, angles with no keels, with sparse feeble striae. Sides weakly defined above, finely striate. First abdominal tergite with practically no furrow, spiracular area quadrate, apophyses obsolete, tergite at base as wide as length of hind trochanter, four times as wide at apex, as long as hind femur + trochanter. Second tergite two-thirds as long as first, as long as apical width. Tergites 1–4 strongly contracted at apex and 2–4 strongly at base. Sixth tergite keeled on apical half. Apical sternites pubescent.

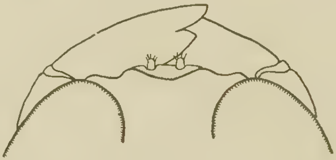


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Fig. 57.—Antero-dorsal view of clypeus of *T. rufidens* Cam., female.

Specimens examined: Type. ♀, Mexico, Cameron coll. (L.). Other specimens: ♀, Mexico, Teapa, Tabasco, March (*H. H. Smith*) (B.C.A.) (det. by Cameron as *T. rugifrons* Cam.). ♀, Panama, Barro Colorado Is., no. 951 (*W. C. Allee*) (W.). In the last mentioned specimen the ocelli are separated by two-thirds their diameter from eyes and by two diameters from one another.

var. **trinidadianum** var. n.

Resembles *T. rufidens* except in the following particulars: Male. Length 7 mm. Eyes separated on occiput by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by two-thirds their diameter from eyes, by one and a half from one another. Area on vertex a little shorter, the keels ending a little earlier. Antennal sockets separated by half their diameter. Antennae with scape one and a half times as broad as greatest breadth, 3 one and a half times as long as broad, 4 one and a quarter times, 5 one and a half times, 6–10 of about the same length as 5 but becoming thicker so that 10 is quadrate, 11–12 transverse, 13 three and a half times as long as broad, rather longer than 10 + 11 + 12; 10 and 11 jointly excavate beneath, 11 thickened at apex beneath and produced under 12, 8–11 keeled beneath. Apex of clypeus somewhat raised and thickened over central quarter which is defined by slight prominences. Mandibles narrower, with an indistinct tooth on dorsal edge. Proepisternal keel less obsolete. Pronotum not impressed in centre. Mesopleuron moderately shining, finely and very closely punctured. Mesonotum and scutellum more shining, finely and closely alutaceous with very fine close punctures. Apex of first three tergites impressed as in the female. Seventh tergite produced into a long spine.

Type. ♂, Trinidad, 27 April '33 (*D. Vesey FitzGerald*) (L.).

This specimen might well be the hitherto unknown male of *T. rufidens* except for the distinctly feebler sculpture of the mesonotum and one or two other details. More material is required to settle its status.

T. duckei sp. n.

Female. Black, mandibles reddish. Posterior margin of pronotum and of pronotal tubercles, fore tibiae and tarsi, narrow base and apex of mid tibiae, base of mid basitarsus, base of hind tibiae, whitish. Wings hyaline. Pubescence silvery. Length 5·5 mm.

Very close to *T. rufidens* Cam., but differing as follows :—Eyes separated at clypeus by hardly more than half the distance they are on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Posterior margin of hind ocelli separated from occipital keel by one and a quarter times the distance between their outer edges. Area on vertex hardly as long as broad, the lateral keels ending at a point level with lower limit of eye-emargination. Antennal sockets separated by one-third their diameter. Antennae with 3 one and a half times as long as broad, 12 nearly twice as long as broad. Clypeus with apical truncate area twice as broad as high (*i.e.* truncation much less marked). Horizontal space behind the buccal cavity hardly narrower. Proepisternal keel almost completely obsolete. Pronotal collar not impressed. Whole thorax less coriaceous and more shining. Propodeum with dorsal area more finely striate, more than twice as long as broad.

Male. A little smaller than female.

Ocelli separated by two-thirds their diameter from eyes, by twice their diameter from one another. Antennae strongly clavate, scape one and a half times as long as greatest width, 3–5 quadrate, 3 not as long as 2, remaining segments similar but progressively thicker, 7–10 keeled beneath, 11 thickened beneath, projecting under 12, 13 strongly tapering, twice as long as broad, as long as 11 + 12. Clypeus with apical margin narrowly emarginate, the emargination defined by small teeth. Mandibles simple. Basal tergites scarcely impressed. Seventh tergite produced into a fine apical hook.

Type. ♀, Brazil, Para, 27 July '01 (*Ducke*) (V.). Allotype. ♂, Brazil, Para, 23 Dec. '99 (V.). Paratype. ♀, labelled " Pöp. Tines " (V.).

T. barberi sp. n.

Female. Black, mandibles red-yellow. Narrow margin of pronotum and pronotal tubercles, narrow apex of all femora, fore tibiae except dark ventral streak, fore tarsi, base and apex of mid tibiae, base of mid basitarsi, base of hind tibiae, whitish. Wings hyaline. Pubescence silvery. Length 5·5 mm.

Differs from *T. rufidens* Cam. as follows :—Eyes separated at clypeus by two-thirds as much as on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4. Ocelli separated by one-third their diameter from eyes, by one and a quarter diameters from one another; posterior margin of hind ocelli separated from occipital keel by one and a half times the distance between their outer edges. Area on vertex a little longer than broad, lateral keels ending at a point level with lower limit of eye-emargination. Antennal sockets separated by one-third their diameter. Horizontal space behind the buccal cavity a little narrower, not quite as wide as greatest width of fore femora. Proepisternal keel obsolete. Pronotum not centrally impressed. Dorsal surface of propodeum relatively shorter with practically no central keel.

Type. ♀, Guatemala, Livingston, 12 May (*Schwarz* and *Barber*) (W.).

This species differs from *T. duckei* in the separation of the eyes from each other, of the ocelli from the eyes, and of the antennal sockets, in the structure of the clypeus, the narrower space behind the buccal cavity and the absence of the keel on the dorsal surface of the propodeum. The following male may be conspecific :—

Length 4·5 mm.

Differs from *T. duckei* sp. n. as follows :—Eyes as in female. Ocelli separated by two-thirds their diameter from eyes, by one and a half diameters from one another. Vertex more finely coriaceous. Raised space on vertex similar, a little broader than long, a little emarginate anteriorly. Antennae with 3–5 a little longer, 3 about as long as 2, 8–11 keeled beneath, 11 hardly projecting beneath. Clypeus with central quarter of apical margin a little raised and thickened (much more like the female than in *T. duckei*).

♂, Panama, Las Cruces, 10 Feb. '11 (*A. Busck*) (W.).

T. capitale sp. n.

Female. Black, narrow apex of antennal segments 1–2, apex of clypeus, mandibles, part of tegulae, fore tibiae and tarsi, narrow base and apex of mid tibiae, base of hind tibiae, hind tarsi, reddish-testaceous. Fore basitarsus and pronotal tubercles whitish. Wings hyaline. Pubescence silvery. Length 6·5 mm.

Differs from the three preceding species in the distinctly (closely) punctured vertex and the more evidently punctured mesonotum.

Differs from *T. rufidens* Cam. as follows :—Ocelli separated by between two-thirds and three-quarters their diameter from eyes, by two and a half diameters from one another. Raised area on vertex smaller, a little longer than broad, lateral keels ending at a point hardly posterior to lower limit of eye-emargination. Antennal sockets separated by one-third their diameter. Truncate apex of clypeus less high. Horizontal space behind buccal cavity narrower, as broad as width of fore tibiae. Pronotum not impressed in centre. Striae of dorsal surface of propodeum much finer and closer.

Differs from *T. duckei* sp. n. :—Separation of ocelli from eyes and from one another greater. Truncate thickening of apex of clypeus only one and a half times broader than high. Horizontal space behind buccal cavity narrower. Dorsal and posterior surfaces of propodeum more finely and closely striate.

Differs from *T. barberi* sp. n. :—Ocelli less close to eyes, etc. Finer striation of propodeum.

Male. Length 5 mm.

Differs from *T. duckei* sp. n. as follows :—Ocelli separated by two-thirds their diameter from eyes, by nearly twice their diameter from one another; posterior margin of hind ocelli separated from occipital keel by one and a half times the distance between their outer edges. Raised area on vertex a little longer than broad, evenly rounded (not emarginate) in front. Antennal sockets separated by hardly more than one-quarter their diameter. Antennae with 6–11 keeled beneath, 7–11 very strongly. Clypeus with apical margin scarcely thickened or emarginate. Horizontal space behind buccal cavity rather narrower than greatest width of fore femur. Vertex and mesonotum more shining, with definite, fine, close punctures. Propodeum with outer side of dorsal area and angles of posterior surface with irregular rugosities, dull. Sides hardly striate except on anterior third.

Type. ♂, Argentine, Salta, 1200 m., 3–11 Feb. '05 (*Steinbach*) (B.). Allotype. ♀, Argentine, Mendoza, 25 Nov. '06 (*Jensen-Haarup*) (B.).

GROUP OF *T. MARGINATUM* CAM.

Antennal sockets separated by a variable distance, either by about half their diameter or by one and a half times. Limiting keels of antennal scrobes (fig. 6) and supraantennal keel replaced by a peculiar system of keels. A strong central keel, sometimes bifurcating below, lies between the antennal sockets. Above, the central keel gives out an arm on each side, the arms reaching at least to the middle of the eye-emargination and sometimes joining one another beneath the median ocellus; a heart-shaped area is thus defined on the vertex. Clypeus with at most a slight projecting lobe or a slight emargination at apex, with appressed silvery hairs (even in female with very few outstanding ones), height considerably less than least width between eyes below (except *T. bellardi* sp. n.). Mandibles simple or sometimes with a small tooth on dorsal edge in the female. Occipital keel complete, horizontal space behind the buccal cavity distinct. Lateral tubercles of pronotum usually obsolete, only distinct and sharp-edged in *T. marginatum* Cam. Angles of pronotal collar not bordered. Proepisternum with no keel, tubercle sometimes prominent or even angular. Prepectus not crossed by any keels or furrows. Mesopleural suture strong for fully half the height of the pleuron. Furrow in front of mid coxae weak or subobsolete, crossed by a few, usually weak, keels. Metapleural keel nearly straight, area defined or not. Lateral lobes of postnotum black, little raised, only with a narrow hyaline area anteriorly in *T. marginatum* Cam. and *T. excellens* Strand. Furrow joining depressions in metapleural-propodeal suture rather strong, crenate. Dorsal margin of orifice of propodeum sharp-edged or a little downcurved, orifice not much broader than high. Fore coxae with no strong apical bristles in the female, keels very variable in strength, subparallel to one another. Mid coxae with a moderately strong outer keel. Hind coxae with a distinct keel on inner edge, usually reaching nearly to apex, and forming actual boundary of dorsal surface; sometimes traces of an external dorsal keel as well; no ventral organ in female. Fore-wings with costa more or less distinctly produced beyond the radial cell (hardly so in *T. excellens* Strand), last section of M_{3+4} and im_1 set at an angle of 90–100°, last section of M_{1+2} 2 to 4 times the length of the penultimate. Two groups of hamuli on hind-wings consisting of 4 and 3 (very rarely 4) hooks each, the groups separated by twice the length of the apical row (rarely by as little as once). Sternites 2–5 hairy almost all over, usually with one stout bristle on each side of apex, more rarely two on each side on some of the more apical ones. Male with eighth sternite (Pl. VI, fig. 10) (*T. shannoni* sp. n. and *T. sulcatoides* sp. n. examined) a little longer than broad, apex pointed, with long marginal hairs and a pencil on each side before apex, dorsal surface anteriorly deeply emarginate. Male genitalia with stipes and squama completely fused, moderately long and narrow; volsellae of two sides only just fused proximally, each one forming a moderately broad lobe, ventral surface of volsella truncate before the dorsal, ventral margin bearing long hairs; a moderately large basal lobe bearing a tuft of hairs and a longer basi-lateral lobe; sagittae rather long and narrow, a little downcurved at apex, where they are thickened beneath; cardo a narrow ring (Pl. IX, figs. 1 and 2).

Small black species, with at most the legs partly pale. The group is found all over America, but appears to be best represented in the extreme south.

The following species, known to me only by its description, may belong to this group.

T. carinatum Say (1837, p. 374), Indiana.

T. excellens Strand (1910).

Female. Black, mandibles and apex of clypeus reddish. Antennae beneath, fore and mid tibiae, narrow base of hind tibiae, annulations of all tarsi, testaceous. Wings hyaline. Pubescence silvery. Length 9 mm.

Occiput dull, alutaceous. Eyes equally separated at clypeus and on occiput where separated by a distance equal to length of antennal segments 3 + 4. Ocelli separated by one-third their diameter from eyes, by one and a half diameters from one another; median ocellus in a feeble depression. Vertex finely coriaceous, a little depressed between the keels, where obsoletely punctured, in region of ocelli more strongly. Keel passing between the sockets and bifurcating below, above with straight, simple section hardly more than half as long as the lower arms, posterior arms extending as far as a little above middle of eye-emargination, then curving round to meet beneath the median ocellus, the posterior part of the arms very feebly raised and consisting of three straight sections rather than a continuous curve. Antennal sockets separated by one and a half times their diameter. Antennae with scape twice as long as greatest width, 3 twice as long as broad, a little longer than 4, 4 and 5 subequal, nearly twice as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad, nearly twice as long as 11. Clypeus evenly rounded. Mandibles simple. Occipital keel complete, horizontal space behind the buccal cavity moderately broad. Tempora beneath rather dull, finely and sparsely punctured. Stipes of maxillae smooth and shining. Proepisternum with tubercles not very prominent. Mesopleuron dull, finely alutaceous, closely and rather finely punctured. Mesonotum dull, finely alutaceous, closely and rather finely punctured. Scutellum similar but more shining, flat. Metanotum flat, closely punctured, lateral lobes striate, posterior margin not hyaline depressions large and deep. Area beneath the metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal surface defined by a weakly crenulate, U-shaped furrow, central impression weak, surface with fine striae which are diagonal at base and transverse at apex. Posterior surface with a narrow furrow, well defined above, ending below at half its length from orifice, no keeled depression, orifice with dorsal margin a little downcurved, angles with no keels, finely striate. Sides defined above, finely striate. First abdominal tergite with no furrow, spiracular area a little longer than broad, apophyses obsolete, tergite at base as broad as length of hind trochanter, one and a half times as wide at apex, fully as long as hind femur + trochanter + coxa. Second tergite two-thirds as long as first, one and a half times as long as apical width. First and second tergites very little contracted at apex. Sixth tergite not keeled. Sternites pubescent.

Specimens examined: Type. ♀, Paraguay, Asuncion, 7 Oct. '05 (*S. Miguel*) (B.). Also ♀, Paraguay, San Bernardino, 12 Jan., in house (*K. Fiebrig*) (L.).

T. sulcatoides sp. n.

Male. Entirely black. Wings hyaline. Pubescence silvery. Length 7·5 mm.

Similar to *T. excellens* but differing as follows:—Ocelli separated by rather more than half their diameter from eyes, by nearly two diameters from one another. Vertex a little more shining. Keel of vertex with lower arms one and a half times longer than single, central keel, posterior arms posteriorly curving inwards but not meeting and almost obsolescent at posterior limit of eye-emargination. Antennae with scape nearly twice as long as greatest width, 3 one and a half times as long as broad, shorter than 4 + 5, 4 and 5 quadrate, 6 longer than 5, remaining segments quadrate, 12 transverse, apex of 9, 10 and 11 keeled beneath, 13 tapering, two and a half times as long as broad, longer than 11 + 12. Propodeum with dorsal area duller, striae more irregular, central impression more nearly obsolete. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad. Second tergite hardly longer than half the first, twice as long as its apical width. Seventh tergite a little truncate. Sternites pubescent.

Type. ♂, Argentine, Mendoza, Cameron coll. (L.). Paratype. ♂, Argentine, Mendoza, 20 Oct. '06 (*Jensen-Haarup*) (B.).

T. segregatum sp. n.

Female. Black, apex of clypeus very narrowly, apical half of mandibles, apical half of last segment of four front tarsi, piceous red. Wings hyaline. Pubescence silvery. Length 10 mm.

Similar to *T. excellens* Strand but differing as follows :—Ocelli separated by two-thirds their diameter from eyes, by nearly two diameters from one another; median ocellus in a distinct, lateral ones in slight depressions. Keel of vertex with lower arms nearly twice as long as single, central keel. Second abdominal tergite only half as long as first.

Male. Keel of vertex with lower arms hardly longer than single, central keel, posterior arms curving round behind median ocellus, defining a strongly depressed, heart-shaped area. Antennae with scape twice as long as greatest width, 3 one and two-thirds times as long as broad, a little longer than 5, 4 quadrate, 5 a little longer, remaining segments becoming quadrate, 12 transverse, 13 tapering, three times as long as broad, longer than 10 + 11 + 12. Seventh tergite truncate. Sternites pubescent.

Type. ♀, Paraguay, Asuncion, Sapucay, 12 Jan. '05 (*J. D. Anisits*) (det. Strand as *T. excellens*) (B.). Allotype. ♂, Argentina, Buenos Aires, 10 Jan. '27 (*F. W. Edwards*) (L.). Paratype. ♀, Argentina (?), Santa Cruz, Hensel (B.).

T. bellardi sp. n.

Male. Black, apical two-thirds of mandibles reddish. Tegulae pitchy. Wings hyaline, a little infuscate at apex. Pubescence silvery. Length 7 mm.

Occiput moderately shining. Eyes much closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4. Ocelli separated by three-quarters their diameter from eyes, by nearly two diameters from one another. Vertex dull, finely coriaceous, disc depressed anteriorly. Keel running half-way down between sockets, diverging just above them and running straight to a point level with upper limit of eye-emargination but distant from it by the length of third antennal segment; area thus not at all defined above. Antennal sockets separated by rather less than half their diameter. Antennae with scape twice as long as greatest width, 2 about quadrate, 3 one and two-thirds times as long as broad, much shorter than 4 + 5, 4 a little longer than 5, both about quadrate, 6–10 about quadrate, 11–12 transverse, 13 four times as long as broad, tapering, longer than 10 + 11 + 12. Clypeus higher than broad, with apical margin produced into a small rounded lobe covering a third of its width. Mandibles with a hardly perceptible tooth on upper margin. Occipital keel complete, horizontal space behind buccal cavity moderately broad. Tempora beneath weakly alutaceous, moderately shining. Stipes of maxillae invisible. Proepisternum with tubercle rather prominent. Mesopleuron moderately shining, very finely alutaceous, closely and moderately strongly punctured. Mesonotum dull, closely (subconfluently) and moderately strongly punctured. Scutellum similar but more sparsely punctured, flat. Metanotum flat, subrugose, lateral lobes striate, posterior margin not hyaline, depressions small. Area beneath the metapleural keel defined. Metasternum not emarginate. Propodeum with dorsal area dull, well defined by a U-shaped furrow, central impression very weak, surface with very fine striae, diagonal at base and transverse at apex. Posterior surface with a deep, narrow furrow, well defined above, meeting the deep keeled depression which is bisected by a longitudinal keel, orifice with dorsal margin a little downcurved, angles with no keels, rather coarsely and irregularly striate, the striae rounded (not sharp-edged) and nearly hidden by the pubescence. Sides well defined above, dull, coarsely alutaceous, with traces of striae above. First abdominal tergite with no furrow, spiracular area quadrate, apophyses obsolete, tergite at base as wide as length of hind trochanter, one and a half times as wide at apex, nearly as long as hind femur + trochanter + coxa. Second tergite two-thirds as long as first, two and a half times as long as apical width. First and second tergites not contracted at apex. Seventh tergite simple. Sternites after first pubescent, sixth somewhat emarginate in centre of apical margin.

Type. ♂, Venezuela, Valera, 1800 ft. (*E. P. de Bellard*) (W.).

T. peltopsis Kohl (1906).

Female. Black, tegulae rather paler. Wings hyaline. Pubescence silvery. Length 8·5 mm.

Occiput moderately shining. Ocelli separated by their diameter from eyes. Vertex densely alutaceous, with close, moderately large, shallow punctures and, anteriorly, fine pubescence. Keel bifurcating below, the lower arms about one and a half times as long as single, central keel, upper arms approach upper limit of eye-emargination (separated by a distance equal to width of antennal segment 4) then curve round and are joined by a short, straight, nearly effaced section in front of median ocellus; area so defined with its sides somewhat raised towards the antennae. Antennal sockets separated by one and a half times their diameter. Antennae with 3 hardly twice as long as broad, a little shorter than 4 + 5, 4 and 5 subequal, rather less than one and a half times as long as broad, apical segments nearly quadrate, 12 twice as long as broad, nearly as long as 10 + 11. Clypeus with apical margin evenly rounded and produced into a slight projection in centre. Proepisternum with tubercle not prominent. Mesopleuron moderately shining, alutaceous, very closely and rather strongly punctured. Mesonotum dull, alutaceous, with very close, large, shallow punctures separated by less than their diameter. Scutellum moderately shining, hardly alutaceous and less closely punctured, flat. Metanotum not impressed, lateral lobes striate, posterior margin not hyaline, depressions small and deep. Area beneath metapleural keel not defined. Metasternum with a very small U-shaped emargination. Propodeum with dorsal surface well defined by a U-shaped furrow, central impression broad and shallow, surface with fine regular striae which are diagonal at base and transverse on posterior two-thirds. Posterior surface with a deep narrow furrow, well defined above, shallowing out just before orifice, no keeled depression, angles without keels, regularly and finely striate. Sides closely and finely striate. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses subobsolete, tergite at base distinctly broader than length of hind trochanter, one and a half times as broad at apex, as long as hind femur + trochanter. Second tergite a little longer than half the first, one and a quarter times as long as apical width. First and second tergites little contracted at apex. Sixth tergite not keeled.

Specimens examined: Type. ♀, Brazil, Rio Grande do Sul (V.). The specimen was returned to Vienna at an early stage of the work, so the description is not quite complete.

T. pentheri sp. n.

Female. Black, mandibles, margin of pronotal tubercles, tegulae, very narrow apex of all femora, fore tibiae and tarsi, mid tibiae and tarsi, narrow base and apex of hind tibiae and annulations of hind tarsi, yellowish-brown. Wings milky-hyaline. Pubescence silvery. Length 6 mm.

Occiput moderately shining, finely punctured. Eyes equally separated at clypeus and on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4. Ocelli separated by one-third their diameter from eyes, by nearly two diameters from one another. Vertex dull, coriaceous, closely and finely punctured, central impression weak. Keel not produced below the sockets, the single, central part as long as second antennal segment, posterior arms straight, directed towards the upper limit of eye-emargination but only as long as antennal segments 2 + 3, forming two sides of an equilateral triangle, beyond this point only indicated as a very slight raising of the surface; area therefore not defined. Antennal sockets separated by one-third their diameter. Antennae with scape twice as long as greatest width, 3 twice as long as broad, much shorter than 4 + 5, 4 and 5 subequal, nearly twice as long as broad, remaining segments all about quadrate, 12 twice as long as broad, hardly as long as 10 + 11. Clypeus with apical margin truncate, with a slight emargination in centre. Mandibles with a small tooth on their upper margin near apex. Occipital keel complete, horizontal space behind buccal cavity narrow, about twice as broad as width of apical segment of maxillary palps. Tempora beneath moderately shining, very finely and closely punctured. Stipes of maxillae smooth and shining. Proepisternum with tubercle not prominent. Mesopleuron moderately shining, closely and finely punctured. Mesonotum moderately shining, very closely and finely punctured. Scutellum more shining, less closely punctured, flat. Metanotum flat, lateral lobes with posterior margin not hyaline, depressions small. Area beneath metapleural keel not defined. Metasternum not emarginate. Propodeum with dorsal area moderately well defined by a U-shaped furrow, central impression shallow, basally with a transverse, crenulate furrow, surface finely and regularly cross-striate. Posterior surface with a narrow, rather deep furrow, well defined above, ending below at half its length from the distinct keeled depression which is bisected by a distinct longitudinal keel, orifice with dorsal margin hardly downcurved, angles with no keels, coarsely and rather irregularly striate. Sides sharply defined above, closely and finely striate, rather dull. First abdominal tergite with no furrow, spiracular area quadrate, apophyses subobsolete, tergite at base as broad as length of hind trochanter, nearly twice as broad at apex, as long as hind femur + trochanter. Second tergite half as long as first, nearly twice as long as its apical width. First tergite slightly, second hardly contracted at apex. Sixth tergite not keeled. Sternites pubescent.

Type. ♀, Brazil, Joazeiro, '03 (*Penther*) (V.).

T. punctivertex sp. n.

Female. Black, apex of clypeus, mandibles and apices of tarsal segments, reddish. Wings hyaline. Pubescence silvery. Length 11 mm.

Occiput shining, hardly punctured. Eyes equally separated at clypeus and on occiput where separated by a distance equal to length of antennal segments 2 + 3. Ocelli separated by one-quarter their diameter from eyes, by one and a half diameters from one another. Vertex dull, with coarse, shallow, subconfluent punctures, which become very deep posteriorly, centrally deeply impressed, especially anteriorly. Keel passing between the sockets and bifurcating below, above with straight, simple section half as long as the lower arms, posterior arms rather strongly raised anteriorly, weak posteriorly, curving round to meet beneath the median ocellus. Antennal sockets separated by one and a half diameters. Antennae with scape nearly three times as long as greatest width, 3 a little more than twice as long as broad, shorter than 4 + 5, 4 and 5 subequal, nearly twice as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad, one and a half times as long as 11. Clypeus evenly rounded. Mandibles simple. Occipital keel complete, horizontal space behind the buccal cavity moderately broad. Tempora beneath strongly shining in neighbourhood of buccal cavity but dull elsewhere, finely and rather closely punctured. Stipes of maxillae smooth and shining. Prosternum with tubercle not prominent. Mesopleuron shining, sparsely and rather strongly punctured. Mesonotum and scutellum shining, closely and strongly punctured, the latter flat. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions large and deep. Area beneath metapleural keel not defined. Metasternum scarcely emarginate. Propodeum with dorsal surface defined by a crenulate, U-shaped furrow, central impression distinct, surface smooth and shining, with traces of striae at base and in impression. Posterior surface with a deep furrow, well defined above, shallowing out in lower half, keeled depression hardly defined, orifice with dorsal margin sharp-edged, angles with no keels, smooth and shining. Sides well defined above, smooth and shining. First abdominal tergite with a very short furrow, spiracular area quadrate, apophyses obsolete, tergite at base a little narrower than length of hind trochanter, twice as wide at apex, nearly as long as hind femur + trochanter + coxa. Second tergite half the length of first, one and a half times as long as apical width. First and second tergites little contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Type. ♀, British Guiana (L.). Paratypes. ♀, Panama, Gatun Lake, Cano Saddle, 3 May '23 (*R. C. Shannon*) (W.); ♀, Brazil, Bahia, 19 March '83 (W.).

T. shannoni sp. n.

Male. Black, antennae with segments 1–11 beneath, narrow apex of clypeus, mandibles, tegulae, anterior surface of mid tibiae, anterior tarsi except dorsal surface of basitarsus, mid tibiae with anterior side and apex narrowly, annulations of mid tarsi, base of hind tibiae very narrowly, annulations of hind tarsi, yellowish-brown. Wings hyaline. Pubescence silvery. Length 7·5 mm.

Occiput shining, very weakly sculptured. Eyes about equally separated at clypeus and on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by one-third their diameter from eyes, by two diameters from one another; median ocellus in a slight pit. Vertex a little shining, inside the area coriaceous, outside it densely alutaceous and finely and closely punctured. Keel passing between the sockets, bifurcating below, above with straight, simple section about as long as lower arms, posterior arms proceeding to a point a little below upper limit of eye-emargination then curving sharply round to meet beneath the median ocellus from which they are separated by twice its diameter, the posterior part of the arms evenly curved and moderately distinct. Antennal sockets separated by one and a half times their diameter. Antennae with scape twice as long as greatest width, 3 one and two-thirds times as long as broad, shorter than 4 + 5, 4 and 5 subequal, hardly longer than quadrate, 6 a little longer, 7–11 quadrate, 10 a little thickened beneath, 11 produced apically beneath into a long hook, so that this segment is deeper than long, 13 tapering, two and a half times longer than broad, a little longer than 10 + 11 + 12. Clypeus evenly rounded. Mandibles narrow at base, towards the apex broadly triangularly dilated, forming a sharp tooth on lower edge, actual tip not visible. Occipital keel complete, horizontal space behind the buccal cavity very narrow, as broad as last segment of maxillary palpi. Tempora beneath shining, finely and moderately closely punctured. Stipes of maxillae smooth and shining. Proepisternal tubercle strongly prominent, forming a backward curving tooth. Mesopleuron moderately shining, feebly alutaceous, rather closely and strongly punctured. Mesonotum rather strongly alutaceous, hardly shining, closely and rather strongly punctured. Scutellum similar but more shining, flat. Metanotum a little convex, lateral lobes striate, posterior margin not hyaline, depressions deep. Area beneath metapleural keel defined. Metasternum invisible. Propodeum with dorsal surface shining, defined by a strong U-shaped furrow, central impression weak, surface with striae which are diagonal at base and transverse at apex. Posterior surface with a broad shallow furrow, well defined above, ending one-third of its length from orifice, no keeled depression, angles with no keels, punctured and obsoletely striate. Sides well defined above, shining, obsoletely striate with a large posteroventral region almost smooth. Hind coxa produced into a small tubercle at apex ventrally. First abdominal tergite with a short furrow, spiracular area one and a half times as long as broad, apophyses obsolete, tergite at base as wide as length of hind trochanter, one and three-quarters times as wide at apex, nearly as long as hind femur

+ trochanter + coxa. Second tergite a little longer than half first, two and a quarter times as long as broad. First and second tergites hardly contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Type. ♂, Peru, Chosica, 3000 ft., 20 Feb. '28 (*R. C. Shannon*) (W.).

T. winthemi sp. n.

Male. Black, tip of mandibles reddish; fore tibiae and tarsi, mid tibiae except a dorsal streak, very narrow annulations of mid tarsi, margin of tegulae, pale brown. Wings hyaline. Pubescence silvery. Length 7 mm.

Occiput moderately shining, finely punctured. Eyes hardly closer together at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by half their diameter from eyes, by one and a half diameters from one another. Vertex dull, rather coarsely coriaceous, with a weak central impression. Keel hardly descending between sockets, straight, central section a little longer than second antennal segment, posterior arms straight, as long as segments 2 + 3 + 4 of antennae, ending at a point equidistant from upper and lower limits of eye-emargination; area therefore not enclosed. Antennal sockets separated by one-third their diameter. Antennae with scape twice as long as greatest width, 2, 3 and 4 quadrate, 5 a very little longer, penultimate segments thicker, quadrate, 10 just transverse, 11 and 12 distinctly so, 13 tapering, two and a half times as long as broad, as long as 10 + 11 + 12. Clypeus evenly rounded. Mandibles simple. Occipital keel complete, horizontal space behind the buccal cavity narrow. Tempora beneath moderately shining, closely and rather finely punctured. Stipes of maxillae smooth and shining. Proepisternum with tubercle not prominent. Mesopleuron rather dull, closely and rather finely punctured. Mesonotum dull, very closely and moderately finely punctured. Scutellum similar but more shining, flat. Metanotum flat, closely punctured, lateral lobes striate, posterior margin not hyaline, depressions very small. Area beneath the metapleural keel not defined. Metasternum invisible. Propodeum with dorsal surface feebly defined by a U-shaped furrow, central impression weak, surface finely, rather irregularly (almost clathrately) striate. Posterior surface with a deep narrow furrow, to near orifice (which is covered with gum), angles finely rugose. Sides well defined above by a crenulate keel, finely striate. First abdominal tergite with no furrow, spiracular area quadrate, apophyses subobsolete, tergite at base a little broader than length of hind trochanter, one and a third times as broad at apex, as long as hind femur + trochanter. Second tergite a little more than half as long as first, two and a third times as long as apical width. First tergite very little, second not contracted at apex. Seventh tergite simple. Apical sternites pubescent.

Type. ♂, Brazil (*Winthem*) (V.).

T. stieglmayri sp. n.

Female. Black, underside of antennal segments 1–6, apex of clypeus indeterminately, mandibles, margin of pronotal tubercles, tegulae, fore femora except base, fore tibiae and tarsi, apex of mid femora, mid tibiae and tarsi, annulations of hind tarsi, yellowish-brown. Base of hind tibiae whitish. Wings hyaline. Pubescence silvery. Length 6·5 mm.

Occiput shining, hardly sculptured. Eyes hardly closer at clypeus than on occiput where they are nearly parallel for a considerable space and separated by a distance equal to length of antennal segments 2 + 3. Ocelli separate by less than one-quarter their diameter from eyes, by one diameter from one another. Vertex dull, finely coriaceous. Keel not passing between the sockets, straight, central section as long as third antennal segment, posterior arms straight, ending very near upper limit of eye-emargination; the area thus not enclosed. Antennal sockets separated by one-third their diameter. Antennae with scape twice as long as greatest width, 3, 4 and 5 subequal, twice as long as broad, remaining segments all somewhat longer than broad, 12 nearly twice as long as broad, much shorter than 10 + 11. Clypeus evenly rounded. Mandibles apparently simple. Occipital keel complete, horizontal space behind the buccal cavity rather narrow. Tempora beneath moderately shining, unpunctured. Stipes of maxillae smooth and shining. Proepisternum with tubercle not prominent. Mesopleuron moderately shining, closely and finely punctured. Mesonotum rather dull, finely and very closely punctured. Scutellum more sparsely punctured, more shining, flat. Metanotum flat, lateral lobes striate, posterior margin not hyaline, depressions deep and circular. Area beneath metapleural keel not defined. Metasternum invisible. Propodeum with dorsal surface rather well defined by a U-shaped furrow, central impression shallow but distinct, whole surface regularly and finely cross-striate. Posterior surface with a shallow furrow, ill-defined above, extending to near orifice, where it ends in a fine transverse keel, no keeled depression, orifice with dorsal margin sharp-edged, angles with no keels, rather regularly striate. Sides shining, well defined above, regularly and finely striate. First abdominal tergite with no furrow, spiracular area quadrate, apophyses obsolete, tergite at base as wide as length of hind trochanter, one and two-thirds times as wide at apex, as long as hind femur. Second tergite two-thirds as long as first, one and two-thirds times as long as apical width. First and second tergites not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Type. ♀, Brazil, Rio Grande do Sul (*Stieglmayr*) (V.).

T. marginatum Cameron (1912).

Female. Black, underside of antennal segments 1–6, narrow apex of clypeus, mandibles, narrow apex of femora, tibiae and tarsi, reddish-yellow. Wings hyaline. Pubescence silvery. Length 8 mm.

Occiput moderately shining, finely sculptured. Eyes hardly closer at clypeus than on occiput where they are separated by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by rather less than half their diameter from eyes, by one diameter from one another. Vertex dull, finely coriaceous, closely but very shallowly punctured. Keel passing between the sockets and bifurcating below, the lower arms about twice as long as the straight, central section, posterior arms very strongly raised, extending as far as upper limit of eye-emargination then curving round and meeting beneath the median ocellus which is distant from the keel by one and a half diameters; area within the keel strongly depressed. Antennal sockets separated by their diameter. Antennae with scape two and a half times as long as greatest width, 3 two and a half times as long as broad, much shorter than 4 + 5, 4 and 5 subequal, about one and two-thirds times as long as broad, remaining segments all a little longer than broad, 12 twice as long as broad, a little shorter than 10 + 11. Clypeus evenly rounded. Mandibles simple. Occipital keel complete, horizontal space behind the buccal cavity moderately broad. Tempora beneath dull, finely and closely punctured. Stipes of maxillae smooth and shining. Proepisternum with tubercle a little prominent. Mesopleuron shining, strongly and rather closely punctured. Mesonotum and scutellum moderately shining, strongly and closely punctured, the latter flat. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions deep. Area beneath the metapleural keel not defined. Metasternum very narrowly emarginate. Propodeum with dorsal surface well defined by a U-shaped crenulate furrow, central impression shallow and crossed by six or seven curved striae, rest of surface obsoletely striate. Posterior surface with a deep furrow, well defined above but almost completely shallowing out before orifice, no keeled depression, orifice with dorsal margin hardly downcurved, angles without keels, coarsely and rather sparsely striate. Sides shining, well defined above, with traces of striae, especially posteriorly. First abdominal tergite with a very short furrow, spiracular area quadrate, apophyses nearly obsolete, tergite at base a little wider than length of hind trochanters, nearly twice as wide at apex, slightly longer than hind femur + trochanter + coxa. Second tergite half the length of first, twice as long as apical width. First tergite distinctly, second not contracted at apex. Sixth tergite not keeled. Apical sternites pubescent.

Male. Length 10 mm. Antennae with segments 1–12 pale beneath. Eyes hardly closer at clypeus than on occiput where separated by a distance equal to length of scape of antennae. Antennae with scape two and a half times as long as greatest width, 3 one and a quarter times as long as broad, much shorter than 4 + 5, 4 and 5 quadrate, remaining segments quadrate, apically becoming thicker, 9 somewhat thickened beneath at apex, 10 thickened at base, 11 first excised then produced into a strong, acute tooth, the three segments together bounding a deep depression, 12 quadrate, somewhat irregular in shape, 13 tapering, three times as long as broad, as long as 3 + 4 + 5. Keel of vertex with lower arms nearly as long as single central part. Proepisternal tubercle strongly raised and angular. Fore coxa beneath flattened and hollowed out, produced into a small tooth before inner posterior angle and into a flat, rounded lobe at anterior outer angle. Seventh tergite simple.

Specimens examined: Type. ♂, British Guiana, Cameron coll. (L.). Female (probably this species), Panama, Cabima, 28 May '11 (*A. Busck*) (W.).

GROUP OF *T. SCUTATUM* CHEVRIER.

Antennal sockets separated by less than their diameter. Limiting keels of antennal scrobes and supraantennal keel replaced by a peculiar system of keels. A strong double keel between the antennal sockets, sometimes bifurcating a little below and with several strong, downwardly-directed bristles arising from between the two keels; typically, the two keels diverge outwards above the sockets and extend to near the centre of the eye-emargination, while just before their extremities another keel is emitted which curves round and, passing behind the median ocellus, meets its fellow from the other side. In many species, however, this system of keels is reduced and the lower keels merely diverge above and end simply before the eye-emargination. Clypeus with at most a small lobe or emargination at apex, with appressed silvery pubescence and moderately numerous outstanding bristles, height about the same as least width between the eyes below. Mandibles simple. Occipital keel incomplete, horizontal space behind the buccal cavity moderately broad. Lateral tubercles of pronotum obsolete. Angles of pronotal collar not bordered. Proepisternum with at most a weak keel, the tubercle sometimes prominent. Prepectus with a more or less distinct transverse mesosternal keel. Mesopleural suture obsolete. Furrow in front of mid coxae weak, hardly crenate. Metapleural keel nearly straight, area not defined. Lateral lobes of postnotum black, little raised. Furrow joining depressions in the metapleural-propodeal suture deep, weakly crenate. Dorsal margin of orifice of propodeum usually produced into a distinct lobe, at least sharp-edged. Fore coxae with no strong apical bristles in the female, keels converging. Mid coxae with a weak keel becoming stronger apically. Hind coxae with a distinct keel on inner edge to apex, basally set in from inner edge of dorsal surface; ventrally with a tubercle or membranous patch in female. Fore-wings with costa more or less distinctly produced beyond the radial cell, last section of M_{3+4} and im_1 typically set an angle of about 75° (but this is variable), last section of M_{1+2} more than twice as long as the penultimate. Two groups of hamuli on hind-wings consisting typically of 6 and 3 hooks each (groups rarely with more nearly equal numbers), the groups separated by more than twice the length of the apical row. Sternites 2–5 with large pubescent patches, with two bristles on each side of apex. Male with eighth sternite (Pl. VI, fig. 12) (*T. scutatum* Chevr. and *T. stroudii* Grib. examined) elongate, dumb-bell-shaped, apex with a semicircular emargination, leaving two narrow, inward-curving lobes. Male genitalia with stipes and squama fused for most of their length, rather broad; volsellae of the two sides just fused proximally, each one forming a long, triangular lobe, basal lobe distinct; sagittae rather long and narrow, moderately downcurved at apex where they are outwardly bifid; cardo a very narrow ring (Pl. IX, figs. 3 and 4).

Small, black species. The group is distributed from Africa, through S. Europe to India and Australia, with one aberrant species in Mexico.

The following species, of which I have examined more or less well-authenticated specimens, belong to this group.

T. abditum Arnold, *T. buddha* Cameron (in part), *T. cognatum* Arnold, *T. connexum* Turner, *T. errans* Saussure (? = *T. gardineri* Cameron), *T. kohli* Arnold, *T. melanurum* Cameron, *T. nigricans* Cameron, *T. pileatum* Smith, *T. punctatissimum* Gribodo, *T. scutatum* Chevrier, *T. scutifrons* Saussure, *T. stroudii* Gribodo.

T. biarti sp. n.

Male. Black, tip of mandibles, tegulae, margin of pronotal collar and tubercles, posterior lobes of mesosternum, fore tibiae except a small apical patch, fore tarsi, basal half of mid basitarsus, narrow base of hind tibiae, whitish. Wings hyaline. Pubescence silvery. Length 8·5 mm.

Occiput somewhat alutaceous, moderately shining. Eyes a little closer at clypeus than on occiput where separated by a distance equal to length of antennal segments 2 + 3 + 4 + 5. Ocelli separated by one-half their diameter from eyes, by one and a third diameters from one another. Vertex dull, densely alutaceous, with close, fine, shallow punctures, central impression feeble. Vertical keels strong between the sockets, joined to their upper edge by fine transverse keels, posteriorly parallel for a short distance, then diverging widely and ending at a point not quite level with posterior extremity of eye-emargination and distant from it by the length of antennal segments 2 + 3; two thick, white bristles arising from between the sockets. Antennal sockets separated by about half their diameter, their edge a little raised. Antennae with scape twice as long as greatest width, 3 quadrate, as long as 2, 4–12 all about quadrate, 13 rather longer, antennae very thick and somewhat clavate, 5 and 6 jointly and deeply emarginate beneath, 6 also projecting beneath 7 at apex. Clypeus with apical margin truncate, somewhat projecting over central fifth. Occipital keel incomplete, horizontal space behind the buccal cavity moderately broad. Tempora beneath shining, hardly punctured. Stipes of maxillae smooth and shining. Proepisternal keel just indicated laterally, tubercle very prominent, ventral surface of fore coxae also strongly convex. Pronotum with centre and angles of collar not prominent, lateral tubercles nearly obsolete. Mesopleuron moderately shining, faintly alutaceous, closely and finely punctured. Mesonotum dull, densely alutaceous, closely and finely punctured. Scutellum similar, but more shining, flat. Metanotum flat, finely punctured, lateral lobes striate, posterior margin not hyaline, depressions large. Metasternum with a narrow emargination. Fore-wings with angle between M_{3+4} and im_1 about 120°. Hind-wings with the groups of hamuli consisting of 4 and 3 hooks each. Propodeum with dorsal surface weakly defined by a U-shaped furrow, central impression weak, with fine striae which are diagonal at base and transverse at apex. Posterior surface with a deep furrow, well defined above, becoming shallow below, no keeled depression, orifice with dorsal margin just downcurved, angles with short keels, weakly rugose below, more striate dorsally. Sides well defined above, shining, with obsolete striae on lower two-thirds. First abdominal tergite with no furrow, spiracular area one and a half times as long as broad, apophyses obsolete, tergite at base as wide as length of hind trochanter, one and a half times as wide at apex, a little longer than hind femur. Second tergite two-thirds as long as first, one and two-thirds times as long as apical width. First tergite little, second hardly contracted at apex. Seventh tergite simple. Apical sternites pubescent. Mid and especially fore femora unusually thick.

Type. ♂, Mexico, Orizaba, '62 (*Biart*) (P.).

This curious species appears to belong to the group of *T. scutatum* Chevr., but is aberrant in a number of ways. It is possible that its characters are the result of a parallel evolution, but this seems rather improbable.

GROUP OF *T. FIEBRIGI* SP. N.

Antennal sockets practically contiguous. Limiting keels of antennal scrobes (figs. 7 and 8) arise from a small transverse keel joining the tops of the antennal sockets; they run for a short distance as a single central keel which soon bifurcates, the arms running parallel for a short distance, then diverging widely and ending abruptly at a point level with the centre of the eye-emargination; the single central keel is further joined by a small keel to the outer edge of each antennal socket. Vertex strongly depressed between the keels. Clypeus with apical margin rounded, with sparse outstanding white bristles, height one and a half times greater than least width between eyes below. Mandibles apparently simple. Occipital keel incomplete, horizontal space behind the buccal cavity broad. Lateral tubercles of pronotum subobsolete. Angles of pronotal collar not bordered. Proepisternum with traces of a keel laterally, tubercle rather prominent. Prepectus with no dorsal furrow but with a strong mesosternal keel. Mesopleural suture not developed. Furrow in front of mid coxae moderately strong, not crenate. Metapleural keel nearly straight, area not defined. Lateral lobes of postnotum raised into moderately high hyaline lamellae. Furrow joining depressions in metapleural-propodeal suture weak, not crenate. Dorsal margin of orifice of propodeum somewhat downcurved, orifice subcircular. Fore coxae without bristles at the apex in the female, dorsal keel strong, ventral keel moderate, parallel to it. Mid coxae with a rather strong keel on their outer edge. Hind coxae in female with a very large pit with a membranous floor, covering half the width and one-third the length of the ventral surface of the coxa, inner dorsal keel removed from edge of coxa basally. Fore-wings with the costa distinctly produced beyond the radial cell, last section of M_{3+4} and im_1 set an angle of about 120°, last section of M_{1+2} 3 times as long as the penultimate. Two groups of hooks on the hind-wings consisting of 5 and 3 hooks each, separated by nearly twice the length of the apical group. Sternites strongly shining, bare except around the bases of the bristles, of which there are 2, 4, 4, and 6 on sternites 2–5. Male unknown.

A moderate-sized, mainly black species, found in the Argentine.

T. fiebrigi sp. n.

As this is the only member of its group only characters additional to those given under the diagnosis of the group are given here.

Female. Black, mandibles, tegulae, narrow base of all tibiae, fore tibiae except dorsally, annulations of all tarsi, reddish. Wings hyaline. Pubescence silvery. Length 11 mm.

Occiput dull, very finely punctured. Eyes separated at clypeus by half the distance that they are on occiput where separated by a distance equal to length of antennal segments 1 + 2 + 3 of antennae. Ocelli separated by three-quarters their diameter from eyes, by one and a half their diameters from one another. Vertex posteriorly strongly convex, strongly depressed between the diverging keels, the depression produced backwards centrally to include the median ocellus, surface dull, with confluent, flat-bottomed, moderately large, honeycomb-like punctures. Antennae with scape twice as long as greatest width, 3 twice as long as broad, much shorter than 4 + 5, 4–6 subequal, nearly twice as long as broad, 7–11 hardly longer than quadrate, 12 two and a half times as long as broad, a little shorter than 10 + 11. Clypeus with apical margin polished, evenly rounded. Horizontal space behind buccal cavity as broad as one and a half times the width of fore basitarsus. Tempora beneath dull, alutaceous, very finely and sparsely punctured. Stipes of maxillae shining, finely alutaceous. Pronotum with centre not, but angles moderately, prominent. Mesopleuron moderately closely and finely punctured. Mesonotum rather dull, finely alutaceous, rather closely and finely punctured. Scutellum more shining and more sparsely punctured, flat. Metanotum flat, finely punctured, lateral lobes with two strong striae, posterior margin narrowly hyaline, depressions moderately large. Metasternum invisible in this specimen. Propodeum with dorsal surface flat, not at all defined, finely and closely cross-striate. Posterior surface with a deep, broad furrow, not sharply defined above, ending at half its length from orifice, no keeled depression, angles without keels, below smooth and shining, above finely striate. Sides not defined above, smooth and shining. First abdominal tergite with a furrow for half its length, spiracular area a little broader than long, apophyses strong but rounded, tergite at base distinctly wider than length of hind trochanter, one and a half times as wide at apex, not much longer than hind femur. Second tergite rather longer than half the first, one and a half times as long as apical width. First tergite little, second not contracted at apex. Sixth tergite not keeled, distinctly punctured and alutaceous towards apex.

Type. ♀, Paraguay, San Bernardino, 21 Sept. (*K. Fiebrig*) (B.).

Group of *T. brevipenne* Saussure.

The essential characters of this group are sufficiently indicated in the key to the groups. Male eighth sternite—Pl. VI, fig. 9. Male genitalia—Pl. IX, fig. 5.

The following species belong to the group: *T. brevipenne* Saussure, *T. buddha* Cameron (in part), *T. elongatum* Smith.

Group of *T. carpenteri* Richards.

The essential characters of the group are indicated in the key and in my paper describing the typical species (1933). There are other, undescribed African species in the British Museum collection. Male eighth sternite—Pl. VI, fig. 7. Male genitalia—Pl. IX, figs. 6 and 7.

Group of *T. mandibulatum* Richards.

The essential characters of the group are indicated in the key and in my paper describing the typical species (1933). So far only this one species from India is known. The association of the male and female still requires confirmation.

Colour Resemblances amongst Species belonging to different Sections of the Genus.

Parallelism in colour-pattern between species of the same or of allied genera is widespread in South American Hymenoptera. In the genus *Trypoxylon* there are some striking instances, the three following being the most remarkable.

Pattern I.

Large, black species, with the mid tarsi mainly white. Wings more or less dark, often bluish iridescent.

To this association belong all members of the groups of *T. albitarse* (18 spp.)

and *T. punctulatum* (6 spp.) and *T. clavatum* and, less perfectly, *T. spinosum* of the group of *T. spinosum.*

Typical members of this association are common and conspicuous American insects. Two or more members of the association are found together from New York to Buenos Aires. In British Guiana they form a conspicuous part of the Hymenopterous fauna gathered round damp, muddy places. Though belonging to the same subgenus, three structurally distinct sections are involved. In the two first groups there is an additional parallelism in the tendency for Southern species to have the fifth segment of the hind tarsi black and for northern species to have it white. The parallelism in this feature, however, is very imperfect.

Pattern II.

Body mainly testaceous, wings yellowish-hyaline, pubescence bright golden.

The members of this association are :—

T. superbum and *T. olfersi* (group of *T. superbum*), Brazil, Central America and Bolivia.

T. semiflavum (group of *T. nitidum*), Bolivia.

T. mutilatum (group of *T. fabricator*), Bolivia.

The above species are at present rare in collections, but apparently Bolivia is the headquarters of the association, though the form of *T. superbum* occurring there is not so similar to *T. semiflavum* as is its Central American variety.

Pattern III.

Black species, of moderate size, base of antennae, pronotum, legs and centre of abdomen, red. Wings dark.

Two species belong to this association, viz. *T. collinum* (group of *T. nitidum*) and *T. johannis* (group of *T. spinosum*). These are structurally very distinct, but are so alike in colour that Smith treated them as one species. At present they are only known from St. John's Bluff, E. Florida, where they were obtained many years ago by E. Doubleday. The type of *T. collinum* is still unique, but I have seen several specimens of *T. johannis*, which may well be the commoner species.

While the colour-pattern of *T. collinum* does not closely resemble that of any other member of its species-group, *T. johannis* is not very distinct in colour from several of its allies.

It might be maintained that these resemblances were an example of Müllerian mimicry, analogous to the reputed examples in *Heliconius* and other S. American Lepidoptera. It is difficult to believe, however, that birds or other predacious enemies could exercise any selection on such quick-flying and relatively small insects as *Trypoxylon.* It is more probable that the resemblances are due to a parallel evolution, based on the restricted number of colour-patterns attainable with a small range of genetic diversity.

The permutation of a limited number of colour-patterns amongst the species of several structurally distinct groups, is scarcely more remarkable than the similar permutations of structural features. Thus the character of the metapleural keel, which may be straight or curved, must also have been the subject of parallel evolution, since each type of keel occurs in the two subgenera of *Trypoxylon.*

A more remarkable analogy is seen in the characters of the sculpture of the thorax. The mesonotum tends to be more heavily and densely punctured in the south of S. America than in the north. Examples are the following :—

Species-group.	N. of S. America (weakly sculptured).	S. of S. America (strongly sculptured).
T. punctulatum	*T. cinereum*, etc.	*T. rogenhoferi*
T. nitidum	*T. fugax* (southern specimens more sculptured)	*T. mutatum*
T. nitidum	*T. nitidum*, etc.	*T. transversistriatum* *T. fractum* *T. optimum*

In the matter of sculpture, however, there are a number of exceptions and only a rather indefinite tendency can be detected.

Biology.

Although only a small proportion of the species have yet been studied there appears to be an important difference in habits between the two subgenera I have established on structural grounds. All species employ mud for building.

Trypoxylon s.s.

Males do not keep guard over the nest (but cf. *T. rugiceps* D.T.). Cocoon whitish to pale brown, dull, silken, larval excrement not incorporated.

Nest usually in artificial cavities, most often in plant stems. Some of the species of the group of *T. fabricator*, however, are known to build mud cells.

Trypargilum subgen. n.

Males keep guard over the nest while the female makes and stores it. Cocoon dark brown, more or less shining, with only a few loose silken threads visible; larval excrement incorporated, to form a hard, shining, brittle case.

Nest usually in artificial cavities of the most varied nature. The species of the group of *T. albitarse* F., however, all build external mud cells. The convergence in the habit of cell-building in the two groups is very interesting, but must, I think, be a parallel evolution rather than a sign of affinity. Nearly all the females (in both groups) known to build these cells have one peculiarity in common—the fore coxae bear strong bristles at their apex. I suspect that this will be found to have some functional significance in nest-building.

Trypoxylon s.s.

Group of *T. figulus* L.

The habits of the three common European species have been summarised by Hamm and Richards (1930, pp. 118–121). (*T. attenuatum* Sm., *T. figulus* L. and *T. clavicerum* Lep.) A number of additional references could be added, but they would not materially alter the account given there. The species nest in cylindrical cavities in wood or in plant-stems. A varying number of cells are divided off with mud partitions. A number of small spiders are stored up, usually about ten in a cell, but the number is variable. The family most often attacked is the Epeiridae, but other groups are by no means avoided. The egg is laid on one of the first few spiders brought in.

T. bidentatum Fox.

Peckham (1898, pp. 78 and 86) and (1905). Wisconsin.

Very common nesting in the stems of plants. In August many were seen hunting for spiders on blackberry bushes. One specimen on a raspberry bush was seen to seize the top of the cephalothorax of a spider, hold it firmly and curve the abdomen round to sting it ventrally. The cocoon is very long and slender, almost white. The adults appear in Sept. (? second brood) and the last cocoon in the nest is the first to give forth its adult.

T. frigidum Sm.

Glover (1878) records a nest in the stem of *Syringa*, Rau (1922, p. 22) in the stem of Sumac, while Taylor (1928) found it nesting in stems of conifers bored by the weevil *Pissodes strobi* (Peck.).

T. plesium Rohw.

Rau (1926, p. 197) (Missouri) records observing this species walk over two spiders' webs without becoming entangled. In (1928, p. 439, figs. 65, 66) he describes the nests in hollow twigs (*e.g.* Sumac). The cells were only one quarter of an inch long.

T. intrudens Sm.

Green (1903) Kandy, Ceylon.

This species was found to nest in any crack or cranny, *e.g.* old nail holes, hollow shaft of a key, stem of disused tobacco pipe, in disused burrows of *Stigmus*, or between covers or pages of books. It could easily be persuaded to nest in glass tubes placed in the corrugations of cardboard. An egg is laid in the cell and then spiders are brought in, all a common local species of small black Attid. The cells deeper in the nest have more provisions than those nearer the exit; the former probably produce females which have a slightly longer larval period. At the posterior end of the cocoon is a constriction into which the larval excrement is received. Lefroy (1909, p. 203) records similar nesting-sites in India.

T. ecuadorium sp. n. Ecuador.

The type female in the British Museum bears a note that it was found nesting in wood.

T. bicolor Sm. and *T. philippinense* Ashmd.

Williams (1931, p. 236) records that these species which have been introduced into Hawaii, nest in hollow twigs, tubes, old borings, folds of paper, etc.

T. elongatum Ashmd.

Williams (1919, pp. 143–5, figs. 73–5) Philippine Islands.

This species is found collecting mud on forest trails and nests in bamboos. In a bamboo of diameter (internal) of 13–15 mm. the cells were 12–47 mm. long (usually about 24) and the nine cells contained about 12 spiders. In another of diameter 8–10 mm. the cells were 14–32 mm. long and there was one spider per cell. The prey belonged to the family ATTIDAE, to a species about 10 mm. long, one or two in a cell. The more recently stored prey were still capable of moving their mouth-parts. The egg was 2·0 by ·65 mm. slightly curved, secured lengthwise over the spider's abdomen with the head directed towards the tail of the victim. The feeding stage lasted five days. The cocoon was 24 by 4·3 mm. with the anterior end sharply truncate. It was cylindrical in shape and joined to the cell-walls by a few threads.

T. rejector Sm.

I have not been able to examine this species, but I presume it belongs to the *figulus*-group.

Horne and Smith (1870, p. 164, figs. 4 and 4*a*). Mainpuri, India.

This species is stated by Horne to build upright, sandy cells on hanging bits of straw, etc. The cells were sometimes arranged spirally around the support. The prey was minute green spiders.

If this observation is confirmed and it is proved that the cells were really built by the wasp and were not old cells of another species which the wasp had adopted, this will form a third group of cell-builders.

Group of *T. scutatum* Chevr.

T. scutatum Chevr.

Cobelli (1900) found this species nesting in the old cells of *Chalicodoma muraria* F. Grandi (1931, p. 50) records the same nesting-site and also the old cells of *Eumenes pomiformis* Rossi. Pigeot (1902) records that it nests in holes in the ground dug by other insects or in holes in old walls. The cells are separated from one another by double barriers, the outer one thin, the inner one thick and hemispherical. Micheli (1929, p. 41) found it nesting in what was probably an old beetle burrow in a fallen tree. There was only one cell and this contained only two small spiders (*Epeira* (*Araneus*) *diademata* Cl. and *E.* (*A.*) *angulata* Cl.).

T. errans Sauss. and *T. scutifrons* Sauss.

Bordage (1912, p. 30). Isle of Réunion.

These two species have similar habits. They nest in cylindrical cavities, especially stems of plants. Also in fissures in bark, and in folds of paper, while they easily adopt paper-covered glass tubes. The prey consisted of species of *Attus* and *Sphassus*. The egg was attached to the side of the abdomen of one of the last spiders brought in. The life-history was as follows: egg 2–3, larva 6–7, spinning of cocoon 2, pupa 15–18 days. The pupae are always arranged with all their heads in one direction and are contained in white, semitransparent, silken cocoons. In glass tubes of 3·5 mm. bore, the cells for females were 2 cms. and for males 1 cm. long.

T. pileatum Sm.

Dutt (1912, p. 200, fig. 5). India.

This Indian species rarely makes her own nest-cavity but uses reeds, thatch, dry empty branches of the Ak plant (*Calotropis* sp.) and of the Pipal tree (*Ficus* sp.) which have previously been bored by *Ceratina*. On one occasion a nest was found in a fold of newspaper. In a few instances the female has been seen removing pith from plant-stems, so that it may do some excavation. The cocoon is thin and brownish. Lefroy (1909, p. 202) states that the species is common about houses, nesting in cane furniture and thatch, etc.

Group of *T. fabricator* Sm.

T. johnsoni Fox.

Rau (1918, p. 137) found this species at Lake View, Kansas, where a specimen was seen to enter a hole in a clay bank. On another occasion it was bred from a hollow stem which had already been used by another insect. Rau (1922, p. 22) records another nest found in Missouri in a mass of soil clinging to the roots of an upturned tree. The burrow was only an inch long.

This is the only one of this group which has been definitely recorded not to build its own cells.

T. fabricator Sm.

Bristowe (1925, pp. 480–2, fig. 3). Brazil, near Rio de Janeiro.

This wasp was found building cells on walls. In one case eight individuals had built their cells in contact. All the cells contained a young Epeirid, *Leucage* sp. At another locality the prey was *Epeira* sp., immature.

Williams (1928, p. 153, fig. 224) describes this species building groups of cells set obliquely from some surface.

A female in the collection of the British Museum collected in Georgetown Botanic gardens by G. E. Bodkin, bears the label " long mud cells on underside of a coconut-palm leaf."

A cell of *T. fabricator* in the British Museum collection (part of the original material from Ega) is made of reddish mud, built up in more or less distinct layers, arranged regularly round the long axis and not forming a V-like arrangement as in *T. albitarse* F., etc. The cell is cylindrical and 20 by 4 mm. in size.

The indications of a gregarious habit in this species are very interesting and the matter requires further investigation. Possibly all the offspring of one female co-operate, somewhat as in *Halictus.*

T. gounellei sp. n.

The type-series of this species bears the label " the nests were fixed to the underside of the leaves of *Cattleyia.*"

T. asuncicola Strand var. *levius* var. n.

A female of this species from Rio de Janeiro collected by E. R. Wagner and now preserved in the Paris Museum bears the label " nest with very narrow cells."

T. silvestre sp. n.

This appears to be a common species in the interior of the British Guiana forests. Its absence from most collections is explained by the small amount of collecting done in this habitat. Most tropical collections are made in coastal regions or in the secondary forests and clearings which fringe the virgin forest.

Four or five nests were found suspended either from the underside of fallen trees or from the spines on the underside of the leaves of spiny palms (Pl. X, figs. 1–3).

Nest no. 902. Nest on the underside of a spiny palm-leaf, hanging free on a single spine, 26 Aug. '29. Pear-shaped nest of granular, pale brown mud, hanging with the blunt end uppermost. The lower end of the nest produced into a moderately acute " dripping-point." Twenty-four cells arranged in a spiral, their orifices which open downwards being successively nearer the centre and further removed from the base. The nest about 30 mm. long and 20 by 30 mm. in section. Cells 18–20 mm. long and 2·5 mm. in diameter.

Nest 6240. In the same situation, 1 Nov. '29. Similar in shape and construction, 33 mm. long, section 23 by 32 mm. Twenty-three cells. In one portion where apparently the nest is not quite completed, it can be seen that the cells are built up of concentric rings of mud and then the whole plastered over with a thin layer. A few cocoon fragments which were preserved were pale brown, apparently silken, tough rather than brittle.

T. moraballi sp. n.

In British Guiana, this also appears to be a forest species and the three nests (Pl. X, figs. 4 and 5) found were overhanging the Moraballi creek attached to the midrib of the underside of a leaf of the Aroid locally known as " Sarsaparilla " (= *Philodendron demerarae* Gleeson, det. Mr. N. Y. Sandwith).

Nest 2284. Hanging from underside of leaf three feet over creek. Made of white, sandy mud. Outer surface quite smooth. Two rows of six and five cells respectively arranged in pairs, orifice downwards. Nest lenticular in shape, 30 mm. long (in vertical plane), section 40 by 17 mm., the long axis coinciding with the mid rib of the leaf. The nest narrows at the point of attachment (where there is 4 mm. of solid peduncle) and below, though there is no definite dripping point. The cells are 22 by 3·5 mm. in size.

Nest 2463, on the same plant, hanging 4 ft. above the creek, 20 Sept. '29. Quite similar, but consisted of two rows of four cells each.

T. rugiceps Dalla Torre (= *T. rugifrons* Cameron).

The nest and habits of a species tentatively ascribed to *T. rugifrons* Cam. are described by Rau (1933, pp. 151–156, figs. 72–75). In view of the difficulties of identification, the actual species concerned is problematical.

The wasp was found on Barro Colorado Island, Panama, attaching groups of mud-cells to walls, buckets, etc., in sheltered positions. Unlike the other mud-nests, the cells were not in contact throughout their length, but only near the point of attachment. The cells were placed in groups of 7–28 and were about $\frac{3}{4}$ inch long. They contained 5–7 spiders, mostly small, and the egg was laid on the first one brought in. Some of the prey were identified as *Argiope argentata* F. and *Epeira* sp., both young. The prey were paralyzed but not dead. The cocoons were made of yellow silk.

In one nest, the author records that a male was always present, but it is not clear from the account that this was an example of the type of monogamy peculiar to the subgenus *Trypargilum.*

T. frioense sp. n.

Dr. Salt kindly allows me to publish his observations on the nest of this species.

Nest 310 (Pl. X, fig. 6). Rio Frio, Colombia, 18 Nov. '26. " A group of small, cylindrical, clay cells, about 15 mm. long and 3·5 mm. in diameter, found on the wall of the house. They are hunched like the fingers of a banana hand, but are cemented together. Three are already open below.

" 20 Nov. '26. A female *T. frioense* emerged.

" 27 Nov. '26. A Chalcid emerged.

" 29 Nov. '26. Five more Chalcids emerged on the previous day; ten cells are now open below.

" 1 Dec. '26. One more Chalcid emerged (total 1 male and 6 females)."

Nest 348. Rio Frio, Colombia, 10 July '27. " On 26 June '27 I took from the wall of the house another group of cells very similar to those of N. 310 and obviously constructed by the same species of wasp. About eight cells made up the group, one being open (unfinished) and one very short, its construction having only just started. To-day (*i.e.* 10 July) three Chalcids have emerged.

"12 July '27. Another Chalcid emerged.

"14 July '27. A male of *T. frioense* emerged.

"15 July '27. A living adult Chalcid found in the remaining closed cell (total 2 males and 3 females)."

The Chalcid has kindly been determined by Dr. C. Ferrière as *Brachymeria* sp.

T. pachygaster sp. n.

A cocoon sent me by Mr. D. Vesey FitzGerald from Trinidad, is pale brown, of a silky texture, dull inside; dimensions 2 × 11 mm.

Subgenus *Trypargilum.*

This is an entirely American group comprising about half the species of that continent.

In all the species which have been observed with any detail it has been found that the male remains in the nest while the female is constructing and storing it. This behaviour practically amounts to monogamous marriage, a type of behaviour which is very rare in any insect which mates more than once, as these are reported to do. A single description of this relationship will suffice since there do not appear to be any significant differences between the species.

The presence of the male in the nest has been recorded in the following species :—

T. fuscipenne F. by Hingston.; *T. cinereum* Cam. (= *albopilosum* Fox) by Peckham and Rau; *T. rubrocinctum* Pack. by Peckham; *T. texense* Sauss. by Hartmann; *T. clavatum* Say by Rau; *T. albitarse* F. (= *politum* Say) by Rau; *T. spinosum* Cam. (= *cinereohirtum* Cam., but see p. 350) by Howes.

According to Rau (1928) the male arrives very early in nest-construction in *T. albitarse* and thereafter spends all his time in the nest, sitting with his head at the entrance. As a rule when the female returns the male flies out to meet her, and usually travels in again on her back. During this process mating often occurs. On other occasions, when the female is storing the nest the male may relieve her of spiders at the entrance so that she wastes no time in entering the nest. Rau also suggests (1928; *T. clavatum*) that the female may feed the male. In *T. albitarse* which builds large mud-cells whose mouths gap widely downwards, Rau has also suggested that the male may help to stop the spiders from falling out.

Group of *T. nitidum* Sm.

T. nitidum Sm.

Bodkin (1917) under the name of *T. fugax* F. records breeding this species from old cells of *Eumenes canaliculata* Ol. Old cells of other wasps appear to be the normal nesting-site of this species.

In the collection of the British Museum is a female with the label "Demarara, Plantation Helena, 13 Oct. '16, bred disused cells of *E. canaliculata*, G. E. Bodkin" (this is a second record), and another female labelled "Georgetown, 20 Nov. '14, G. E. Bodkin, bred from circular mud-cells." In the U.S. National Museum is a male and female (no. Z. 2363) bred by Zetek from a mud-nest, Ancon, Canal Zone, Panama, 7 March '23. Mr. A. M. Gwynne has shown me three males bred from cells of a *Polistes* nest collected at the Imperial College of Tropical Agriculture, Trinidad. In the Paris Museum are several specimens from French Guiana collected by F. Geay in 1900. One lot was bred from cells in an old nest of *Polybia* (*Protopolybia*) *pygmaea*, and the other from cells in an old nest of *Apoica pallida* Ol. The cells in the latter nest (according to the note on the label) were closed by a double barrier of mud, the outer one being the thicker. The cocoon is dark brown, a little shining, one end rounded, the other a little narrowed, then truncate, length 10 mm. A specimen in the Berlin Museum (Paraguay, San Bernardino, 30 Dec., *K. Fiebrig*) bears the label " in a hole in a mud-wall."

Dr. Salt has kindly allowed me to publish some notes he made on a nest of this species observed in Colombia (Nest 308, Rio Frio, 12 Nov. '26).

" Nest taken from a tree behind the office, seems to be composed of cells arranged in eight linear rows, usually about three or four cells to a row. The whole is plastered over with thin layers of mud. The nest looks like an old nest of *Pelopaeus* being used again and it seems likely that the three or four cells in each row are secondary, each row being the equivalent of one original cell. Two or three cells opened contained uncoloured pupae of a species of *Trypoxylon*.

" 17 Nov. '26. The nest was broken open and two fully formed adults were extracted from two cells. They were fully active and flew vigorously. Two pupae with only the eyes coloured and one dead larva in a cocoon were also extracted. Several stored Blattidae filled one large cell."

The nature of the prey in the large cell suggests that the *Trypoxylon* was using an old *Podium*-nest.

T. fugax F.

According to F. Smith (1857, p. 77) this species was bred at Petropolis, Brazil, from old cells of a *Polistes* which were stopped with red earth.

T. aurifrons Shuck. (= *ornatum* Sm.).

Bates (1876, p. 186) bred this species from cells which were evidently those of a Eumenid. Bertoni (1929, p. 224) also records that this species nests in the abandoned cells of other Hymenoptera.

T. rubrocinctum Pack.

The Peckhams (1898, p. 77; 1895; 1905) studied this species in Wisconsin. It was nesting in large numbers in the straw of thatch and also in holes in wood. A whole nest could be completed in one day and one female even stored four in a day. The prey was spiders of many families but chiefly Epeirids. The female took 10–20 minutes or often longer to get a spider, while the storing of it also took some time. The prey are often more or less alive when stored and some of them remained so for two weeks after the nest was opened up. There were 7–14 spiders per nest, the egg being laid on the last spider brought in or at least one of the later ones. The egg hatched in 40–60 hours and the larva fed for 7–8 days. Cocoons gathered in August emerged in the following May and June.

Rau (1922, p. 22) found a nest in an elder-twig in Missouri. The hollowed-out portion was three inches long and one-eighth inch in diameter. The lowermost cell contained a black cocoon from which a wasp emerged in late July. The other cell was parasitised by a Chrysid.

T. melanopteron sp. n.

Six males in the collection of the Paris Museum, Chaco de Santiago del Estero, banks of Rio Salado, near Icano (*E. R. Wagner*), bear the note that they were bred from cells found in empty *Polistes*-cells.

Group of *T. punctulatum* Taschenberg.

T. punctulatum Tasch. nests according to Bertoni (1929, p. 224) in the abandoned cells of other Hymenoptera, in Paraguay.

T. rogenhoferi Kohl.

Cocoons of this species from Prov. Santiago del Estero, near Icano (*E. R. Wagner*), are preserved in the Paris Museum. They are dull brown, brittle about 15 mm. long. In one both ends are rounded, one having a little loose silk attached; the diameter is 4·5 mm. In the other the general shape is similar, but one end (that with the silk) is expanded into a mushroom-shaped structure whose diameter is 9 mm. Whether this is at all normal to the species requires confirmation.

T. cinereum Cam. (= *T. albopilosum* Fox).

The Peckhams (1898, p. 77; 1895; 1905) studied this species in Wisconsin. It nested in holes made by beetles in wood: 25–30 spiders were stored in each nest. The prey belonged to many genera and families, but was chiefly Epeirids. Sometimes the prey were so large that they had to be dragged in, *e.g.* in the case of *Epeira insularis*.

A female from Tobago Is., Oct. '13 (*G. H. Sworder*), in the collection of the British Museum, bears the following label, "wasp after stinging the spider found him too heavy and bit off each leg then started to fly away with it." Such mutilation is well known in certain Psammocharids but requires confirmation in a *Trypoxylon*.

Rau (1926, p. 199; 1928, p. 423) studied *T. cinereum* in Missouri, where it was nesting in old bee-burrows in a clay bank. The wasp occurred from June to Sept. The prey was entirely *Epeira*-species and was sometimes alive when brought in.

Ashmead (1894, p. 45) records that this species preys on an Aphid, but this must be an error.

Group of *T. spinosum* Cam.

T. tridentatum Pack.

Rau (1918, p. 134) found this species nesting at Lake View, Kansas, in an elder-twig that had already been once used as a nest by another Hymenopteron. Six and a half inches had been hollowed out, but only the top three inches were partitioned off and used. The cells were about three-quarters of an inch long.

T. rufozonale Fox.

H. S. Smith (1908) records that he found this species nesting in a clay bank in Nebraska. One nest contained twenty-two spiders.

T. texense Sauss.

Hartmann (1905, p. 57) in Texas found that this species would occupy any convenient crevice in wooden or stone walls, adopting either horizontal or vertical holes. Empty cartridge cases standing upright were also used. In these latter sites the cells were in two layers. Another site was the old nests of mud-daubing wasps. A female might make two cells in a day. The prey included spiders of the families Attidae, Thomisidae and Epeiridae and 8–25, average 15, were stored in a cell. In nests of two cells, the deeper one always contained more spiders than the outer one. The prey were brought in alive and lived for three days.

Rau (1928, p. 441) found this species in Missouri and Illinois, and in the latter locality the cells were abundant in abandoned nests of *Sceliphron caementarium* Drury. Sometimes the cells were closed with a double plug. Hungerford and Williams (1912, p. 248, and fig. 5) in Texas record nests from deserted bee-burrows in a clay bank; the prey belonged to several families.

T. spinosum Cam. (*cinereohirtum* Cam.).

Beebe, Hartley and Howes (1917, p. 394) and Howes (1919, p. 27) studied in British Guiana a species which they identified as *T. cinereohirtum* Cam. The range of *T. spinosum* does not appear to extend as far as this into S. America and probably the identification was incorrect. Possibly they had some allied species under observation.

Howes states that the species inhabits all sorts of holes, as penholders, spools, nail holes, handle of shaving glass, etc. The bottom of the nest was made by a double plug of mud and the cells were 20 mm. long. Five to eight spiders were stored in a cell, the egg being laid on the side of the abdomen of the last, largest spider brought in. The cell was closed by a double plug, 6 mm. thick. The egg hatched in 2, the larva fed for 4, the resting larval stage was 10 and the pupal period 23 days. One to three cells were found in each nest. The cocoon was constructed of brown, varnished silk. According to Howes all the spiders for the three cells are collected on one day and are separated by half-made partitions and the egg is then laid in the three cells in quick succession. A confirmation of this modification of mass-provisioning would be desirable.

T. clavatum Say.

The commonest site for the nests of this species appears to be the old cells of mud-daubers (Ashmead, 1894, p. 45; Viereck, 1916, p. 677; Rau, 1916, 1918, 1928). Other sites are old *Polistes*-cells (Rau, 1922, p. 22), old bee-burrows (Rau, 1926, p. 198; 1928, p. 406) and old beetle-burrows in wood (Rau, 1928). On one occasion Rau even found it burrowing in wood itself.

At St. Louis, Mo., Rau found two generations a year, the first towards the end of June, the second in Sept. Rau (1918) describes a social flight in which both sexes engaged, but no mating was observed. In eleven cells belonging to several nests there were 6–11 spiders (average 8·4) belonging to many families and quite mixed even in one cell. The cells are sometimes closed with a double plug. Rau (1916) describes interesting modifications of instinct when old nests of mud-daubers are used. Those of *Sceliphron caementarium* and *Chalybion caeruleum* are adopted almost unchanged, only the debris is cleaned out or shut off at the bottom by a partition. In one case a still living pupa of *Chalybion* was shut off in this way. The cell is then divided by partitions and a new plug fitted to the entrance. In old nests of *Trypoxylon albitarse*, on the other hand, the cells are made in the empty cocoons of the original occupant; these are lined with mud. One nest from Kansas produced *T. cockerellae* Rohw., which is here regarded as a variety of *T. clavatum*.

T. salti sp. n.

A specimen captured by Dr. Salt, Rio Frio, Colombia, 6 July '27, was found nesting in a knot-hole in a window sill.

Group of *T. albitarse* F.

T. palliditarse Sauss. (= *leucotrichium* Rohw.).

This is probably the species referred to by Bates (1876, p. 186) as *T. albitarse.* At Santarem, Brazil, it builds tubular cells (? tiers) three inches long, often on walls or doors and preys on spiders. The female makes a lot of noise while building. Bertoni (1929, p. 224) probably refers to this species under the name of *T. rostratum* Taschbg. which, he says, always builds its own cells, while other species of similar appearance (group of *T. punctulatum*) use the old nests of other insects. Bristowe (1925, p. 481) (as *T. albitarse*) found this species common near Rio de Janeiro, building its cells on walls and rock-faces. The prey belonged to the family Epeiridae, in one colony containing nothing but *Micrathena bifurcata* Hahn, one of the hard, spiny members of this group.

Bruch (1932) has given an account of the habits of this species in Argentina. He describes how the male associates with the female, even in nest-building. He figures the details of the structure of the nest. The female attacks Argiopid spiders and kills them with one sting in the dorsal region. The egg is laid on the first spider brought in and there is an average of seven prey to the cell. He describes the larva, cocoon and pupa. As prey, he records *Araneus* (= *Epeira*) *lathyrinus* Holmbg., *A. vagus* Keyserl., *A. audax* Blackw., *A. worckmanni* Keyserl.

Mr. A. M. Gwynne has allowed me to examine a male of this species which he bred at the College of Tropical Agriculture, Trinidad. The cell was of reddish mud and shows the same V-shaped series of mud-layers that have been figured for *T. albitarse.* From the remains preserved, it would appear that the cell was about 18 by 6 mm. in size. The cocoon was brittle, dull brown, with one end rounded and the other truncate.

Howes (1919, p. 40) (as *T. leucotrichium*) states that in British Guiana this species nests in reeds, entering the hanging cut ends from below. The cells were $1\frac{3}{4}$ to 3 inches long and contained four spiders. The incubation period was 2, larval 6, spinning 2 days. The cocoon was a silken network over which the excreta were worked by strange muscular contortions of the abdomen. Sixteen days after spinning it pupated and the adult emerged in six days more. This account differs so much from that given for the species by other authors that I suspect that a member of the *T. punctulatum* group may have been observed, though doubtless the actual specimen sent to Rohwer was correctly identified. Rau (1933, p. 157) also gives short notes on the nest in Panama. Five paralysed spiders were stored in a cell, the egg being laid on the dorsum of the prey, which consisted of Epeirids.

T. buchwaldi sp. n.

This is probably the species studied by Williams (1928, p. 153, fig. 214) in Ecuador. Specimens collected by him from Bucay were found to belong here. He figures a large number of parallel cells attached to a rock face.

T. albitarse F. (= *T. politum* Say).

The best accounts of this species are given by Rau (1916; 1928, p. 428). The cells are attached to smooth surfaces or more rarely to such objects as hanging corn-husks. In the latter site the cells are completely cylindrical instead of having one side flattened. When attached to flat surfaces the cells may either be completed by the surface itself or the latter may be daubed with mud. The cells are built up of layers of mud, forming a series of V-shaped pieces (see figs. in Dow, 1930*a* and Osborne (1929)). When completed the cells are not covered over with an irregular layer of mud as are those of other mud-daubers. During construction a long pipe is built first and then a series of cells is partitioned off inside it. One nest found by Rau consisted of a single tube 20 inches long, but usually several " organ-pipes " are built side by side. One female took three weeks to build two tiers each four inches long, but probably the usual rate is faster than this. Usually one tier is completed before another is begun. The period between egg-laying and pupation is something under 23 days, and in one case the pupal period was 27 days (summer generation). The adult emerges by a hole in the side of the cell. It has only the instinct to bore through one wall so that if it accidentally emerges in the cell of another individual it stays there and dies unless that specimen has already made its exit-hole. The prey recorded by Rau entirely consists of species of *Epeira.*

An analysis made by Rau (1916) of the contents of 43 nests (1282 cells) from St. Louis, Mo., was as follows :—

972 produced adults; 126 were sealed and stored but had no egg; 27 sealed empty; 2 unsealed and empty; 1 unsealed and stored; 4 with dead larva and insufficient food; 20 with dead larvae but sufficient food; 37 with dead prepupae; 12 with dead pupae; 13 with dead adults; 26 with *Melittobia*; 14 with *Anthrenus*; 28 with Ophionine or Dipterous parasites. These nests had between 3 and 42 cells, there being no indication that any particular cell-number was specially frequent.

Dow (1930*b*) has transcribed some of the early accounts of the habits of this wasp by Bartram (1745), Catesby (1748) and Latrobe (1809). Notes on the reactions of the wasp to light are given by Turner (1912).

T. mexicanum (Saussure) Rohwer (recorded as *T. albitarse*).

Du Buysson (1898) has published some bionomic notes on this species from the observations of Diguet in Mexico. The species can easily be identified by Du Buysson's figure of the male clypeus. The nest figured was of three tiers of 6, 6 and 2 cells, respectively. The prey consisted of two species of *Epeira*, one being *E. oaxacensis* Keyserling. The larva and cocoon are also figured, the latter being brown, cylindrical and rounded at both ends.

T. fuscipenne F.

A nest of this species was found by Major R. W. G. Hingston in the store-tent of the Oxford University Expedition to British Guiana, 1929. The two tiers of two and one cells each were attached to the side of a box of food and the male was present in the cells while they were being built. The cells were 62 × 6 mm. in size.

Brief notes on the nests, accompanied by photographs, are given by Rau (1933, pp. 156–7) for two species of this group, identified as *T. cinereum* Cam. and *T. niveitarse* Sauss. respectively. The first mentioned specific name is almost certainly incorrectly applied and the second is very doubtful.

Ashmead (1894, p. 45) states that *T. collinum* Sm. (group of *T. nitidum*) and *T. carinifrons* Fox = *fastigium* Fox (group of *T. figulus*) prey on Aphids, but this must be an error.

PARASITES AND PREDATORS.

I have collected into one place all the information I have been able to find as to enemies of *Trypoxylon.* A good deal of information as to European species was quoted in Hamm and Richards (1930); parasites, etc., noted in that paper are quoted here without reference to the original record.

Birds.

Rau (1916, 1928) records that the Blue Jay (*Cyanocitta cristata*) destroys many nests of *T. albitarse* F.

Acarina.

Rau (1916, 1928) records *Pediculoides ventricosus* Newp. as a scavenger in the nests of *T. albitarse* F.

Coleoptera.

Williams (1928, p. 154) found a Rhipiphorid in a nest of *Trypoxylon* sp. in British Guiana.

Rau (1916 and 1928) records *Anthrenus scrophulariae* F. as a moderately important invader of the cells of *T. albitarse* F. *Tenebrio obscurus* F. is more of a scavenger in the old debris.

Megatoma undata L. attacks *T. figulus* L. (Hamm and Richards).

Diptera, TACHINIDAE.

Pachyophthalmus signatus Meig. attacks *T. attenuatum* Sm. and *T. figulus* L. (Hamm and Richards); *T. clavicerum* Lep. (Chevalier, 1922); *T. albitarse* F. (Allen, 1926).

P. distortus Allen attacks *T. albitarse* F. (Allen, 1926).

P. aurifrons Townsend attacks *T. cinereum* Cam. (*albopilosum*) (Peckham, 1898, p. 77). This species of parasite is the same as *P. signatus* according to Allen.

Sarcomacronychia trypoxylonis Towns. attacks *T. albitarse* F. according to Rau (*loc. cit.*) and *T. palliditarse* Sauss. according to Bruch (1932, p. 57). This parasite is the same as *P. floridensis* Towns. according to Allen.

Miltogramma punctatum Mg. recorded by Hamm and Richards from *T. figulus* L.

Diptera, ANTHOMYIDAE.

Eustalomyia hilaris Fall recorded by Hamm and Richards from *T. figulus* L.

Strepsiptera.

Richards (1930) records an unidentified Strepsipteron from *T. tridentatum* Pack., and refers to a similar record by Sickmann from *T. figulus* L.

Hymenoptera, CHALCIDIDAE.

Brachymeria sp. is recorded by Myers (1932, p. 134) from *Trypoxylon* sp. in Trinidad and by Rau (1933, p. 155) from *T. rugiceps* D.T. (or allied species). In the present paper, a species of *Brachymeria* is recorded from *T. frioense* sp. n. (p. 347).

Melittobia acasta Wlk. is recorded from *T. figulus* L. (Hamm and Richards), from *T. attenuatum* Sm. (Chevalier, 1930).

Unidentified species of *Melittobia* are recorded from *T. scutifrons* Sauss. and *T. errans* Sauss. (Bordage, 1912), *T. cinereum* Cam. (= *albopilosum*) (Peckham, 1898, p. 77), *T. texense* Sauss. (Rau, 1928, p. 441), *T. albitarse* F. (Rau, 1916).

Eurytoma rubicola Gir. is recorded from *T. attenuatum* Sm. and *T. figulus* L., while *E. verticillata* Nees and *E. nodularis* Boh., which may not be distinct, are recorded from the second species only (Hamm and Richards).

A Cleonymid is recorded by Rau (1928, p. 439) from *T. plesium* Rohw.

Hymenoptera, GASTERRUPTIONIDAE.

Gasterruption assectator L. is recorded from *T. figulus* L. (Hamm and Richards).

Hymenoptera, ICHNEUMONIDAE.

Hoplocryptus binotatulus Thoms. recorded from *T. attenuatum* Sm. (Schmiedeknecht, 1931). *H. rubi* Haberm. from *Trypoxylon* sp. by Habermehl (1919, p. 287).

Kaltenbachia dentata Tschek recorded from *Trypoxylon* sp. by Seyrig (1927, p. 210).

Cecidonomus inimicus Gr. var. *gallicola* Bridg. from *T. attenuatum* Sm. by Habermehl (1922, p. 281). *C. mediterraneus* Tschek from *T. figulus* L. by Hamm and Richards.

Isadelphus armatus and *Leptocryptus pellucidator* Gr. are recorded by Schütze and Roman (1931) from *T. figulus* L.

Ephialtes manifestator L. recorded from *T. clavicerum* Lep. by Hamm and Richards, and *E. tenuiventris* Hagn. from *T. figulus* L. by Schütze and Roman (1931).

Perithous mediator Gr. and *P. divinator* Rossi recorded by Hamm and Richards from *T. figulus* L.

Stenodontus marginellus Gr. recorded by Hamm and Richards from *T. figulus* L. Rau (1916) records an Ophionid from *T. albitarse* F.

Hymenoptera, CHRYSIDIDAE.

Chrysis (*Trichrysis*) *cyanea* L. recorded from *T. figulus* L. and *T. attenuatum* Sm. by Hamm and Richards.

C. (*T.*) *parvula* F. recorded from *T. rubrocinctum* Pack. by Rau (1922, p. 22) and from *T. albitarse* F. by Rau (1916).

C. (*T.*) *tridens* Lep. from *T. albitarse* F. by Rau (1916).

C. (*Tetrachrysis*) *ignita* L. recorded from *T. figulus* L. by Hamm and Richards, and from *T. attenuatum* Sm. by Enslin (1929, p. 122).

C. (*T.*) *splendidula* Rossi recorded from *T. figulus* L. by Hamm and Richards, and from *T. scutatum* Chevr. by Trautmann (1928, p. 171).

C. (*T.*) *fulgida* L. recorded from *T. figulus* L. by Hamm and Richards.

C. (*T.*) sp. recorded by Rau (1928, p. 439) from *T. plesium* Rohw.

C. (*Hexachrysis*) *fasciata* Ol. recorded from *T. figulus* L. by Hamm and Richards.

C. verticalis Patton recorded by Ashmead (1894, p. 45) from *T. fastigium* Fox.

Omalus auratus L. recorded from *T. figulus* L. and *T. attenuatum* Sm. by Hamm and Richards.

O. pusillus F. recorded from *T. figulus* L., *T. attenuatum* Sm. and *T. clavicerum* Lep. by Hamm and Richards.

Omalus violaceus Scop. (*caeruleus* Dahlb.) var. *virens* Mocs. recorded by Chevalier (1929) from *T. attenuatum* Sm.

Hymenoptera, MUTILLIDAE.

Sphaerophthalma scaeva Blake recorded by Rau (1916) from *T. albitarse* F.

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EXPLANATION OF PLATES VI–X.

PLATE VI.

Eighth sternites of male *Trypoxylon* in dorsal view.
Subgenus *Trypargilum.*

FIG. 1. *T. spatulatum* sp. n. (Group of *T. albitarse* F.).
2. *T. rogenhoferi* Kohl (Group of *T. punctulatum* Tasch.).
3. *T. aestivale* sp. n. (Group of *T. albitarse* F.).

Subgenus *Trypoxylon* s.s.

FIG. 4. *T. fabricator* Sm. (Group of *T. fabricator* Sm.) (ventral view).
5. *T. nitidissimum* sp. n. (Group of *T. fabricator* Sm.).

Fig. 6. *T. cornigerum* Cam. (Group of *T. fabricator* Sm.).
7. *T. carpenteri* sp. n. (Group of *T. carpenteri* sp. n.).
8. *T. gracillimum* Sm. (Group of *T. figulus* L.).
9. *T. brevipenne* Sauss. (Group of *T. brevipenne* Sauss.).
10. *T. sulcatoides* sp. n. (Group of *T. marginatum* Cam.).
11. *T. sanctum* sp. n. (Group of *T. figulus* L.).
12. *T. stroudii* Grib. (Group of *T. scutatum* Chevr.).

Plate VII.

Group of *T. albitarse* F.

Fig. 1. Male genitalia of *T. aestivale* sp. n., seen from the right.
2. Right stipes of *T. aestivale* sp. n.
3. The same of *T. atkinsoni* sp. n.
4. The same of *T. fuscipenne* F.
5. Male genitalia of *T. busckii* sp. n., seen from the right.

Group of *T. spinosum* Cam.

Fig. 6. The male genitalia of *T. salti* sp. n.
7. The aedeagus of *T. arizonense* Fox, dorsal view.
8. Aedeagus of *T. tridentatum* Pack., seen from the right.
9. Male genitalia of *T. tridentatum* Pack., dorsal view.
10. The same of *T. salti* sp. n.

Plate VIII.

Group of *T. punctulatum* Tasch.

Fig. 1. Male genitalia of *T. rogenhoferi* Kohl, in dorsal view.
2. Aedeagus of *T. rogenhoferi* Kohl, seen from the right.

Group of *T. nitidum* Sm.

Fig. 3. Aedeagus of *T. excavatum* Sm., seen from the right.

Group of *T. fabricator* Sm.

Fig. 4. Male genitalia of *T. cornigerum* Cam., dorsal view.
5. The same of *T. nitidissimum* sp. n.
6. Apex of aedeagus of *T. nitidissimum* sp. n., seen from the right.

Group of *T. figulus* L.

Fig. 7. Male genitalia of *T. caldesianum* sp. n., dorsal view.
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9. The same of *T. sanctum* sp. n.
10. The same of *T. gracillimum* Sm.

Plate IX.

Group of *T. marginatum* Cam.

Fig. 1. Right half of male genitalia of *T. shannoni* sp. n., dorsal view.
2. Right half of male genitalia of *T. sulcatoides* sp. n., ventral view.

Group of *T. scutatum* Chevr.

Fig. 3. Male genitalia of *T. scutatum* Chevr., dorsal view.
4. The same, seen from the right.

Group of *T. brevipenne* Sauss.

Fig. 5. Male genitalia of *T. brevipenne* Sauss., dorsal view.

Group of *T. carpenteri* Rich.

Fig. 6. Male genitalia of *T. carpenteri* Rich., dorsal view.
7. Aedeagus of *T. carpenteri* Rich., seen from the right.

Plate X.

Fig. 1. Nest of *Trypoxylon*, almost certainly *T. silvestre* Rich., hanging from a rootlet on the underside of a log. Nest with "dripping point." Moraballi Creek, British Guiana. (Photo. J. E. Duffield.)
2. Nest of *T. silvestre* Rich., hanging from a spine on underside of leaf of spiny palm. Moraballi Creek. (Photo. J. E. Duffield.)
3. Another view of the same nest. (Photo. G. V. B. Herford.)
4. Side view of nest of *T. moraballi* Rich. A piece of twig takes the place of the underside of the mid rib of the leaf (*Philodendron demerarae* Gleeson) to which it was attached. Moraballi Creek. (Photo. G. V. B. Herford.)
5. Another view of the same nest. (Photo. G. V. B. Herford.)
6. Nest of *T. frioense* Rich., Rio Frio, Colombia (*Dr. G. Salt*). (Photo. G. V. B. Herford.)

Index to the Specific Names.

Page-references in italics refer to synonyms or species which are not described on that page.

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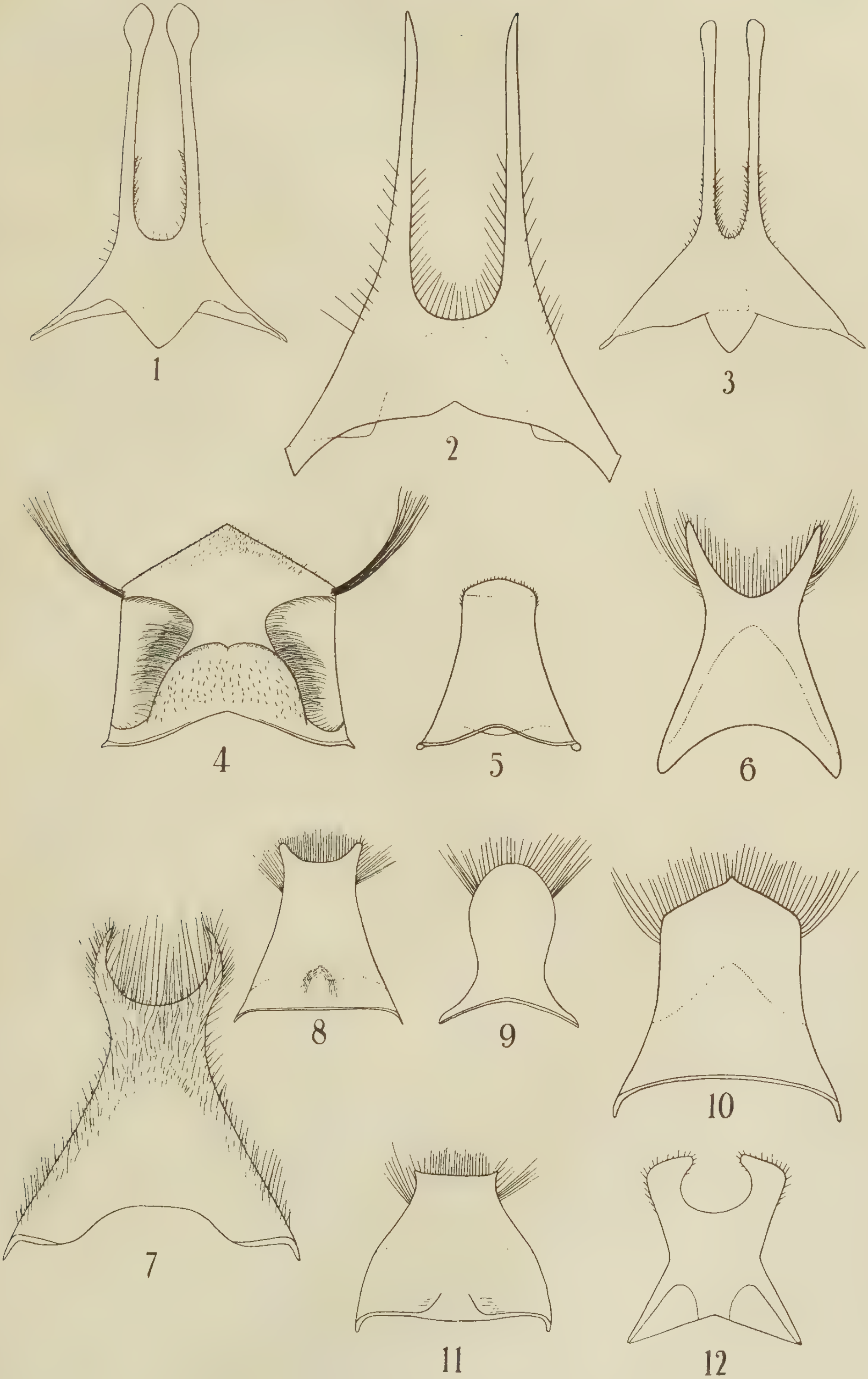
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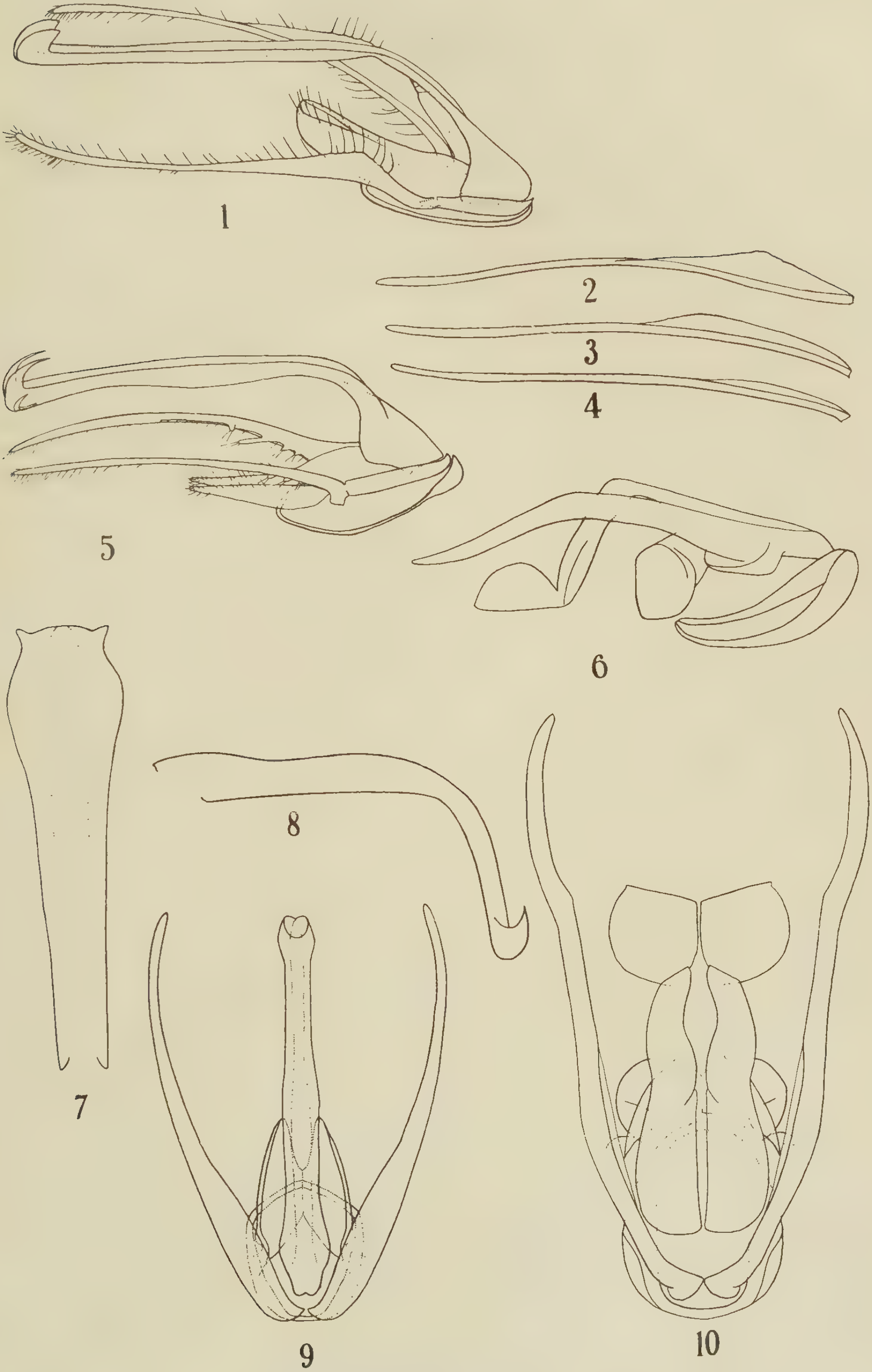
Eight sternites of male *Trypoxylon* in dorsal view.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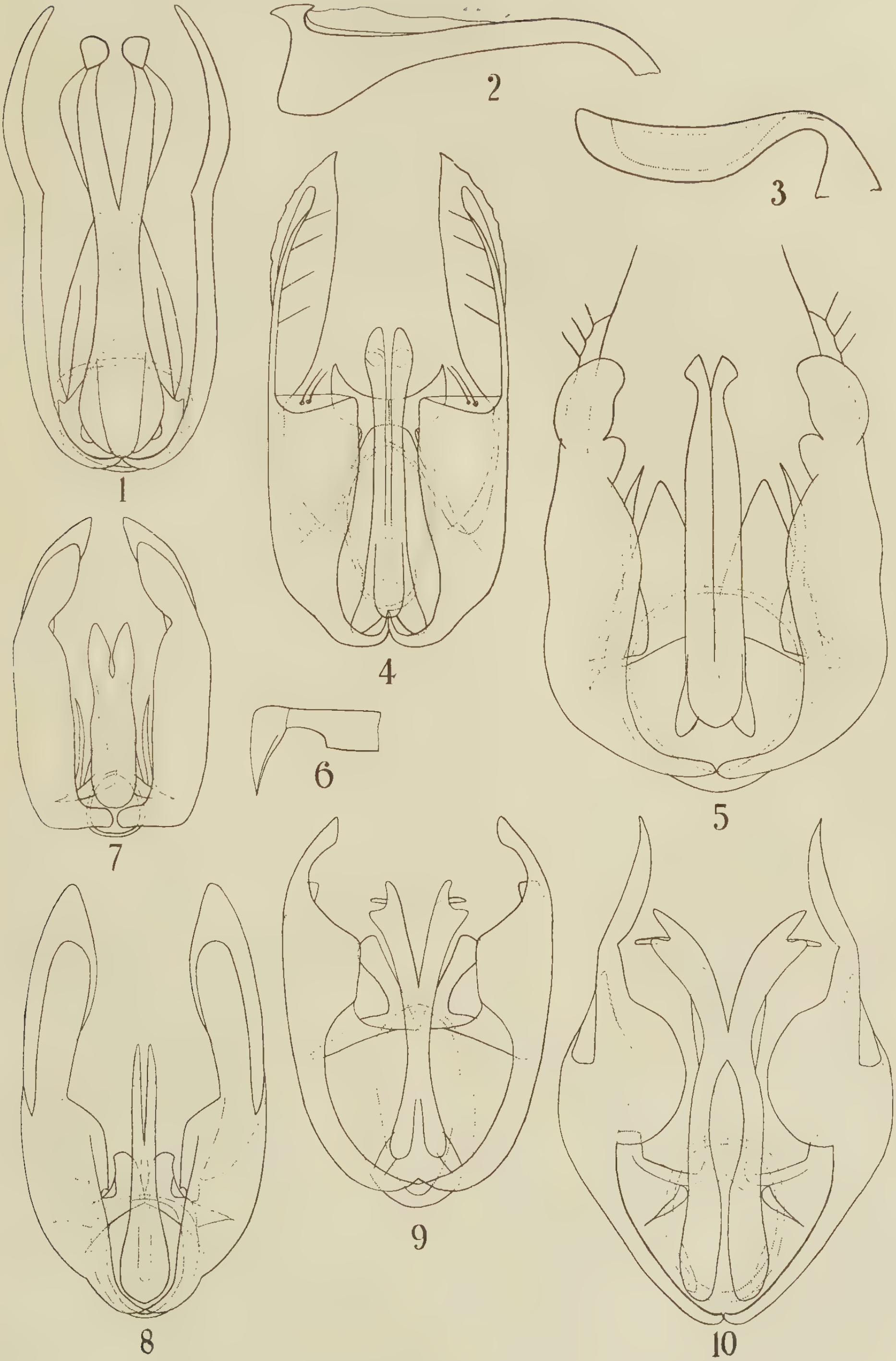
Male genitalia of *Trypoxylon.*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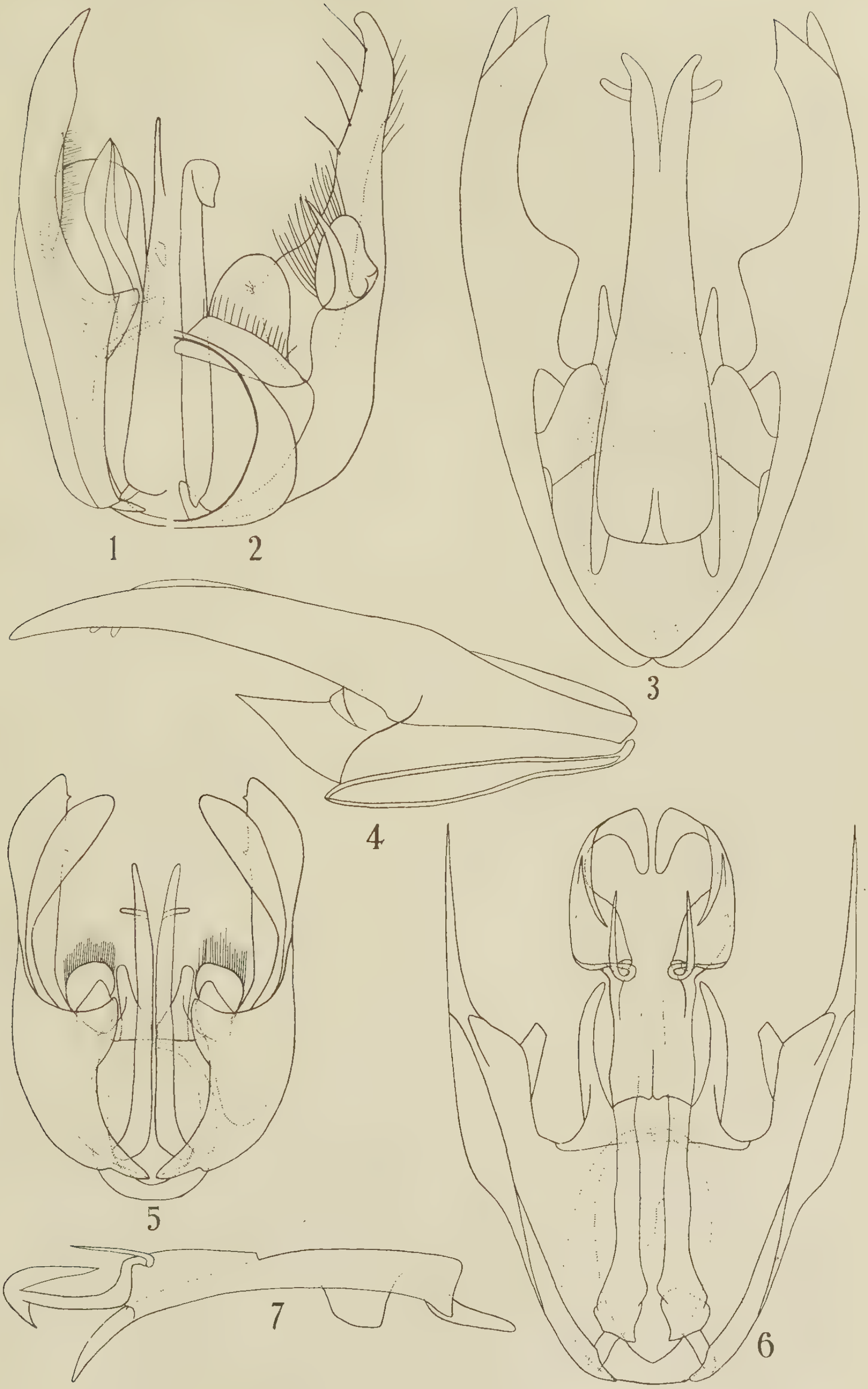
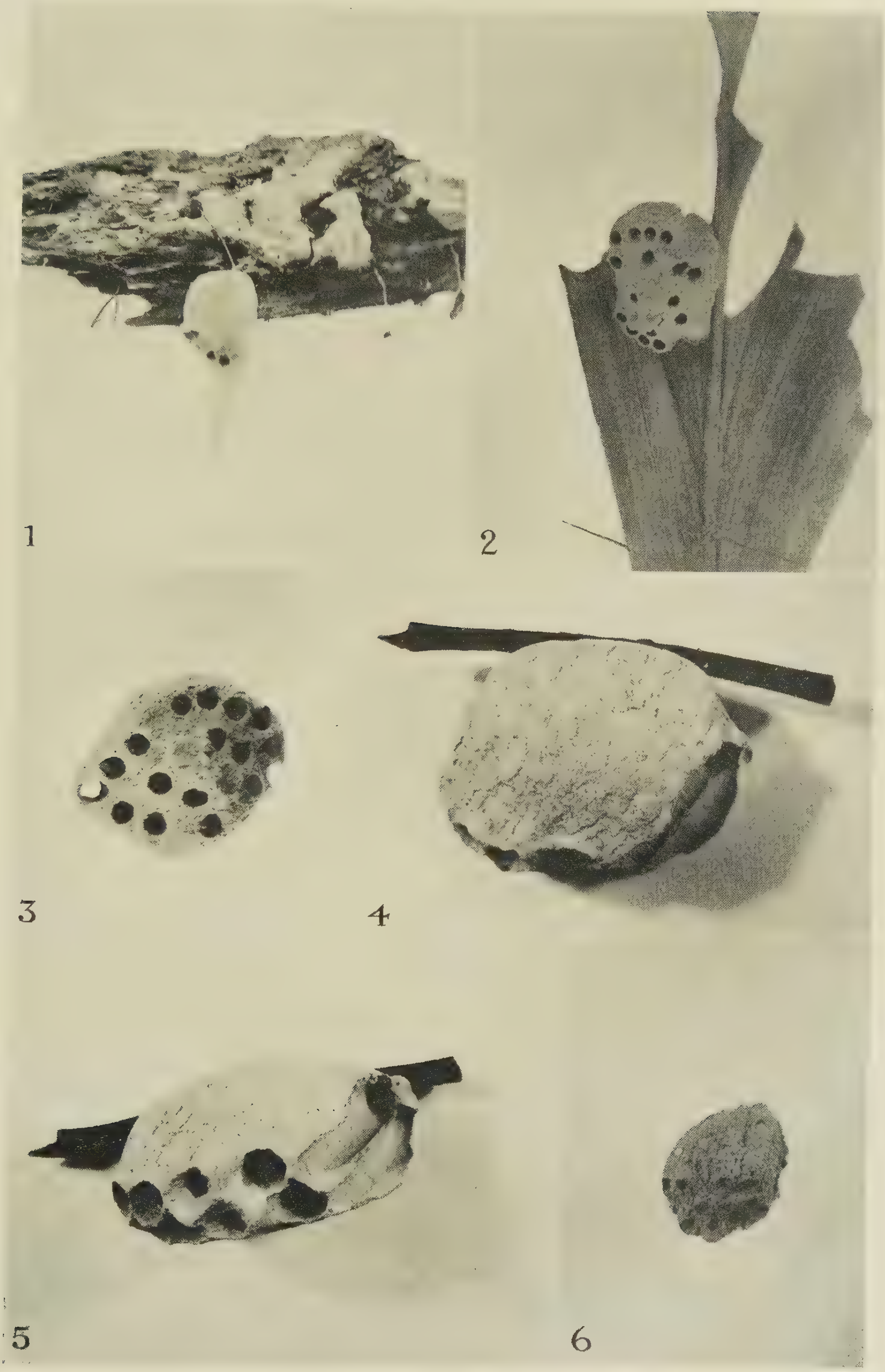
Male genitalia of ***Trypoxylon.***



Male genitalia of ***Trypoxylon.***

WESTWOOD BEQUEST.



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THE BIOLOGY OF SCOTTISH PSYLLIDAE

By K. B. Lal, M.Sc., Ph.D.

(Department of Agricultural Zoology, University of Edinburgh.)

[Read 6th June, 1934.]

With Plates XI–XIV.

The major part of the work on the biology of Psyllidae has been done on species of economic importance. Two of the most injurious Psyllid pests, the apple- and the pear-suckers, have been studied extensively both in Europe and America. Attention has been paid to other species according to their relative importance as pests. Regional faunistic studies of Psyllidae, in which their habits and biology rather than their economic importance have been stressed, are not numerous. Of the early works of this kind mention may be made of the papers of Maskell (1889), Froggatt (1900–1902) and Uichanco (1921). More recently the biology of a number of Italian species of Psyllidae has been studied by Boselli (1929–31).

The following account is based on a study of the biology of ten species of Scottish Psyllidae, not including *Psyllia mali* Schmidb. and *P. peregrina* Först., the status of which as two biological races of a single species is discussed in another paper * (Lal, 1934*b*). The species dealt with here are grouped according to their host-plants, and for the sake of convenience, the systematic descriptions of their nymphal stages have been published elsewhere (Lal, 1934*a*).

This research was commenced under the direction of Dr. C. B. Williams. Later, on his departure to Rothamsted Experimental Station, the work was carried on under the supervision of Dr. A. E. Cameron, to whom I am indebted for advice during the progress of the investigation and also for much helpful criticism of this manuscript. My thanks are also due to Mr. F. Laing, for either confirming or correcting the identifications of the Psyllidae submitted to him. Finally, I wish to acknowledge gratefully a grant made by the Trustees of the Moray Endowment Fund of Edinburgh University by which the expenses of this investigation were, in part, defrayed.

(Subfamily Psyllinae.)

Alder Psyllids.

Psyllia alni Linn. and *P. försteri* Flor.

Seven species of *Psyllia* have been recorded on alder, of which two, *P. alni* and *P. försteri*, are European and British and were found in this region. Of the other five *P. fusca* Zett. and *P. alpina* Först. have been reported from various parts of Europe, and the remaining three, *P. floccosa* Patch, *P. galeaformis* Patch and *P. trimaculata* Crawf. from Canada and the United States.

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* See also Lal, *Nature*, **132** : 934, Dec. 16, 1933.

TRANS. R. ENT. SOC. LOND. 82. PART II. (DEC. 1934.)

In addition to these a species of *Trioza* from North Germany, *T. lepidoptera* Rud, is suggested by Aulmann (1913) as living on alder.

The chief American species of *Alnus* infested by the Psyllids are *incana*, *tenuifolia* and *rhombifolia*; in Europe *glutinosa* and *incana* are most commonly attacked, while *Alnus viridis* is said to be the host of *P. alpina*. My specimens were collected from *glutinosa*, *incana* and *nitida*, and judging by their occurrence round Edinburgh, *glutinosa* is most favoured by *P. alni* and *P. försteri*.

Neither of these two species can be regarded as a pest, although in cases of heavy infestation the nymphs retard the growth of new shoots, and, to that extent, the early maturing of young trees.

Distinction between the Species.

Although colour is not always a sure criterion in determining species of Psyllidae, yet in the field, throughout the summer until early autumn, *alni* may be recognised as the green and larger and *försteri* as the yellow and smaller species. The following table gives the chief differences between the two :—

P. alni.	*P. försteri.*
1. Larger species. Length 5 mm.	1. Smaller species. Length 4 mm.
2. Costal vein and stigma green, other veins except basal piece of subcosta black. Elytra whitish hyaline.	2. Veins dull yellow. Elytra hyaline with a feeble ochreous tinge.
3. Anal valve of female narrowing posteriorly, apical third blade-like, beset with long setae dorsally and smaller ones ventrally. Subgenital valve sword-like, broad in its basal two-thirds, narrowing abruptly in its apical third, beset with numerous large, pointed setae.	3. Anal and subgenital valves uniformly tapering to apices; former irregularly corrugated dorsally in its apical third. Setae small and few. Subgenital valve shorter than anal valve and ovipositor.
4. Anal pore-ring two-layered, outer pores round, inner elongate and conical, so arranged that apex of one usually coincides with base of another.	4. Anal pore-ring two-layered (3 in places) outer pores round, inner elongated, the two often confluent.
5. Forceps of male slightly semi-lunar, thickly beset with long pointed setae on inner side. Tips heavily sclerotised and pigmented, ending in 2 or 3 thick small claws.	5. Forceps with tips slightly swollen, heavily sclerotised and pigmented, ending in 7 or 8 sharp-pointed setae.

Life-history.

The life-history of *P. alni* resembles that of *P. försteri* except that the various stages of the latter precede those of the former in point of time. The degree of infestation due to *P. försteri* in the Edinburgh locality is distinctly less than that due to *P. alni*, where the latter species is about six times as numerous as the former. In the London district, on the other hand, *P. alni*, according to Edwards (1896), is said not to be common, whilst *P. försteri* is very common.

Both the species have but a single generation in the year and winter is passed in the egg stage.

Adult. The adults of *P. alni* appear towards the end of June, and those of *P. försteri* about 10 days previously. The insects are active on warm bright days and may often be seen poised in the air about alder trees. Very soon, however, they become dispersed to other neighbouring trees, so that the number of adult insects on alder does not compare with that of the earlier occurring nymphs. *P. försteri* starts mating about the second week of July and *P. alni* a week later. The following account is drawn from an observation made on *P. alni* :—

Shortly before mating the male is seen to make excited advances toward several females before it finally approaches and settles on top of one. Immediately, the male abdomen is curved towards the genital opening of the female, and the anal valve and forceps of the former serve to separate the anal and subgenital valves of the latter, when the now straightened aedeagus is inserted into the opening thus revealed. The head and thoraces of the pairing insects are always kept apart by an angle varying from 75° to 180°, when they face in opposite directions, often moving about with posterior ends thus linked. Mating may last from 10 to 40 minutes.

Egg laying does not commence till the third week of September. By this time the ovaries are well developed and contain many mature eggs together with a larger number of immature ova. In females of *P. alni* captured on 20.ix.32 and dissected the same day, the number of ovarioles in either ovary was found to vary from 30 to 40 and the total number of mature eggs in each ovary was 12 to 18. From this time onwards eggs may be found out of doors. The greatest egg-laying activity of *P. alni* seems to occur about the first week of November and of *P. försteri* some days before, as the latter disappear earlier than the former. Both males and females die a few days after oviposition has ceased. Before it commences, however, there is a return migration of the dispersed insects to the original host, as evidenced by the greater numbers captured on alder towards autumn.

Egg. In spite of careful search, the eggs of *P. försteri* were not found in the field. Since they are invariably concealed from view, their discovery is more or less a matter of chance. Examination and comparison of the eggs dissected from the abdomen of females during the egg-laying period, however, readily helped to differentiate those of the two species, and in this way eggs collected in the field were all identified as those of *P. alni*.

The following description of the egg of *P. försteri* is based on an examination of the ovarian egg :—

Length, ·55 mm. Greatest breadth, ·20 mm. Length of basal stalk, ·08 mm.

Broadly oval with apex slightly narrower and very blunt, base rounded with a narrow hollow stalk into which the inner membrane of the egg penetrates as a thin transparent streak.

Distal stalk absent.

Egg of *P. alni* (field specimen).

Length, ·47 mm. Greatest breadth, ·19 mm. Length of basal stalk, ·15 mm. Length of distal stalk, ·05 mm.

Elongated oval, sharply narrowing towards apical end; with two stalks, basal long with a prolongation into it of inner membrane, distal shorter having no communication with egg cavity. Chorion smooth and shiny. White when first laid, deep yellow after about 10 days.

Eggs are laid concealed in the crevices of the bark of the older branches of alder. Each is attached to the wood by its broad end, where the long stalk arises and pierces the host tissue. Their disposition is never linear, but often divergent in all directions from a central point and sometimes scattered irregularly but rather closely in groups. The maximum number of eggs found in a group was 16.

Nymph. Eggs of *P. alni* start hatching in the first week of April, those of *P. försteri* about a week later, but the latter contrive to reach the adult stage more quickly because of their shorter nymphal life. By the middle of April first instar nymphs of both species may be encountered on alder shoots just beginning to open. Altogether there are five nymphal instars, and wing rudiments appear in *P. försteri* towards the beginning, and in *P. alni* towards the end, of the second instar. Moulting takes place by a dorsal longitudinal splitting of the cuticle of the head and thorax, and immediately after each ecdysis the insect is pale yellowish and somewhat transparent.

Habits of the Nymphs.

The first two instars of both species occur on and between the opening leaf-buds. Later instars feed in the axils of leaves and even of small twigs. Little or no secretion is produced by the first two instars, but with the beginning of the third instar, a white sticky, paste-like substance appears at the posterior ends of the nymphs, which are, further, soon enveloped in a mass of white fluffy, silk-like and extremely fine threads. The secretion thus is clearly of two kinds and its production is greatest in the last two instars. The nymphs in all stages are active when disturbed and do not live gregariously.

Colouration of the Adult.

As in many other species of PSYLLIDAE, the colour of the adult changes with the season. Although the change is gradual and transitions abound, it is possible to differentiate typical summer and autumn forms. These are described below :—

Summer Colouration of *P. försteri.*

General body colour greenish-yellow. *Head* yellowish-green. Antennae brown with distal third of segments 4–6 and segments 7–10 black. Eyes deep brown edged with a lighter band of same colour. Ocelli deep orange. *Thorax :* Pronotum greenish-yellow. Dorsulum and mesoscutum yellow with indistinct brown patches. Metathorax green. Elytra hyaline with an ochreous tinge. Legs brownish-yellow. *Abdomen* yellowish-green with posterior margins of segments dark. Female genitalia progressively yellowish, brown towards tip. In males tips of forceps dark, rest of forceps and anal valve brownish-green.

Summer Colouration of *P. alni.*

General body colour deep green. *Head* green with two broad yellow spots on vertex. Basal segment of antennae green, second segment brown, rest progressively dark. Eyes deep brown. Ocelli deep orange. *Thorax :* Pronotum yellowish-green anteriorly, yellow posteriorly. Mesothorax green with brown patches. Metathorax brown. Elytra whitish-hyaline. Legs yellowish-brown, green in places. *Abdomen* yellowish-green, becoming progressively darker posteriorly. Genitalia in female green in basal half, brownish posteriorly; in males, forceps deep green, anal valve yellow.

Autumn Colouration of *P. försteri.*

General body colour brown. *Head* brownish-yellow. Antennae deep brown. Eyes dark. Ocelli deep red. *Thorax :* Pronotum yellowish. Dorsulum brown, green at corners. Mesoscutum brown with dark patches. Metathorax brown. Wings with a deep brown tinge. Legs brown. *Abdomen* brown.

Autumn Colouration of *P. alni.*

General body colour reddish-brown. *Head* dark red. Antennae and eyes deep brown. Ocelli deep red. *Thorax :* Pronotum red at sides, greenish towards middle. Dorsulum, mesoscutum and rest of thorax deep red with dark patches. Wings with a dusky tinge. Legs dark brown. *Abdomen* deep red. Female genitalia dark brown, male brown.

ASH PSYLLIDS.

Psyllopsis fraxinicola Först. and *P. discrepans* Flor.

The following six species of PSYLLIDAE have been recorded as living on ash, all belonging to the genus *Psyllopsis* :—

1. *P. fraxini* Linn.; 2. *P. discrepans* Flor; 3. *P. distinguenda* Edwards; 4. *P. meliphila* Löw; 5. *P. fraxinicola* Först.; 6. *P. mexicana* Crawf.

Of these the last two are American species, the first five European and the first three and the fifth British. In S.E. Scotland *P. fraxinicola* is very abundant, *P. discrepans* less common and *P. fraxini* scarce.

The one and only host species in the Edinburgh locality is *Fraxinus excelsior*, although other species of *Fraxinus* are also infested elsewhere. *P. discrepans*, however, is recorded by Edwards (1896) to have been taken by beating *Circaea lutetiana* and other low-growing plants, and *P. fraxinicola* is said by Krause (1916) to live on *Corylus* as well. The former of these two records at least is very doubtful.

Economically, *P. fraxinicola* is mentioned many times as a pest of ash in the United States, especially by Felt (1910–1915) in the reports of the State Entomologist. The same author (1911) writes that this species does little damage in Europe, a statement not borne out by my observations. In Scotland, at least, not only *P. fraxinicola*, but *P. discrepans* and *P. fraxini* are capable of doing damage, although only the first named becomes sufficiently abundant to cause appreciable injury.

Specific Distinction.

The following table will serve to separate the six species of the genus *Psyllopsis* :—

Psyllopsis.	
Body yellow to yellowish-brown. Tegmen free from dark markings. 1. *fraxinicola.* 2. *meliphila.* 3. *mexicana.*	Body brown to blackish-brown. Tegmen with conspicuous dark markings. 4. *fraxini.* 5. *discrepans.* 6. *distinguenda.*
Smallest species, slightly darker—*meliphila.*	Largest species, markings on tegmen sharply defined. Forceps in lateral aspect an irregular triangle attached by apex—*distinguenda.*
Antennae over 4 times as long as width of head. Male anal valve very slender, forceps long and triangular—*mexicana.*	Forceps hatchet-shaped with a tuft of setae on inner sides, attached by very slender stalk—*discrepans.*
Antennae about 2½ times as long as width of head. Male anal valve broad in lateral aspect, forceps notched in middle, hairy at sides—*fraxinicola.*	Forceps hammer-shaped, thickly beset with setae on inner side—*fraxini.*

Life-history.

Felt (1911) stated that *P. fraxinicola* had a life-history similar to that of the pear psylla and the adults overwintered. My observations do not bear out this statement, and in this region both *P. fraxinicola* and *P. discrepans* pass the winter in the egg stage and are univoltine.

Adult. The adults of *P. fraxinicola* appear about the middle of June and those of *P. discrepans* a little later. Ten or twelve days after emergence the ovaries begin to mature, and the insects start mating. In a number of females of *fraxinicola* dissected on 17.vi.33 there were on an average about 20 mature eggs in the ovarian tubules of each insect, this number being 7 in the case of *discrepans*. Oviposition, however, does not begin till early autumn.

Egg. Except for a small difference in size, the eggs of *P. fraxinicola* and *P. discrepans* are exactly similar. It was, therefore, not easy to distinguish them when collected in the field, and the following average measurements are of eggs dissected out from the ovarioles :—

Species.	Length in mm.	Greatest breadth in mm.	Length of stalk in mm.
P. fraxinicola . . .	·36	·13	·09
P. discrepans . . .	·43	·17	·13

Eggs of both species are oval, rounded towards the ends, with a stout stalk about one-fifth from the proximal end. They are laid singly on unopened leaf-buds, the stalk often inserted on the inner side, *i.e.* next to the stalk of the twig, and on this account are difficult to detect. They are white when first laid, becoming brownish later.

Hatching starts about the second week of April, just when the leaf-buds are about to open and continues for a considerable time afterwards. This synchronisation of hatching and the opening of the leaf-buds has been discussed for *Psyllia mali* eggs by, among others, Theobald (1909), Lees (1916), Brittain * and Minckiewicz (1927), the last author believing that eggs hatch early or late according to the degree of development achieved before winter begins. This agrees with my observations in which three green twigs of apple, bearing a large number of eggs of *P. mali*, and kept in the laboratory in moist sand, burst into leaf in the last week of February, but the first eggs did not hatch till the third week of March. In the case of the eggs of *Psyllopsis* two facts are noteworthy : (1) hatching occurs first when the buds of the ash are about to open; (2) it continues for a considerable time after the first buds have opened. These observations suggest that, in *Psyllopsis*, while the time of oviposition is probably the most significant factor in the hatching of the egg, the physical condition of the host may also be important by reason of the heat generated by the flow of sap in developing trees as stated by Theobald (*loc. cit.*), or by a physiological connection existing between the egg and the host, as mentioned by Lees (1916), or through both.

Nymph. The first instar nymphs of *P. fraxinicola* and *P. discrepans* are encountered in the field towards the middle of April, and thence various immature stages may be collected till the end of June. The first two instars of the former are yellowish, those of the latter pinkish in colour. The nymphs of both species moult five times before becoming adult and the duration of each instar, where known, is as follows :—

P. fraxinicola	IV	instar	9 days.
	V	,,	11 ,,
P. discrepans	II	,,	11 ,,
	III	,,	11 ,,
	IV	,,	9 ,,
	V	,,	10 ,,

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* Cited by Minckiewicz (*loc. cit.*).

Habits of Nymphs and Adults and their effects on the Host.

The first nymphs to hatch creep in between the folds of the half-opened leaf-buds and start feeding singly on them. Towards the end of the second instar, the characteristic curling of the ash leaves becomes evident, and many third-instar nymphs, together with a large number of first and second instars from later hatched eggs, may now be found inside the curled leaves.

The last three stages of *discrepans* are passed entirely inside the galls. In the case of *fraxinicola*, nymphs of the last two instars may also be observed moving outside on both surfaces of the leaves, and in heavy infestations they may be found assembled on the petioles as well. The most pronounced habit of the adults is to attach themselves to the hard woody parts of the ash tree, where they are found sometimes arranged in a line one above the other.

The nymphs produce three kinds of secretions differing mainly in their physical characteristics. A few hours after hatching small droplets of a white sticky substance are secreted from the circumanal pores, and simultaneously there is also produced long stiff waxy filaments rising from the bases of the setae surrounding the body margin. These filaments are very fragile and easily break off, but they withstand the macerating action of alcohol longer than the material exuded from the circumanal pores. A third kind of secretion, produced in the later stages of nymphal life, is in the form of a profuse, fluffy, cottony substance that often envelops the nymphs, and adheres to all parts of the host-tree like strands of cotton wool. This secretion emerges from the numerous pores that occur on the dorsum of the nymph. Droplets of white waxy substance are also secreted by the adult females.

As a result of the feeding activities of the nymphs on the host, there are formed copper-coloured galls due to the involution of the leaves from the margins inwards. At first the gall is small and spindle-shaped, and only a small area of the leaf is affected; later, larger parts of the leaf surface are rolled up until the whole leaf is involved. On being unfurled the gall reveals a seething mass of nymphs of all stages, invested by their fluffy, cottony secretion.

Late in summer, when many of the nymphs have become adults, the galls are infested by other insects, which often prey on the adult Psyllids and in time become the sole occupants of the erstwhile habitation of their nymphs. These include earwigs, capsids, thrips and spiders. Of these the first two are predators on both the species of *Psyllopsis.*

Colouration of the Adult.

Unlike many other Psyllids *P. fraxinicola* and *P. discrepans* change little in colour with the advance of the season. The former, however, becomes a little more yellowish and brownish and the latter, likewise, a little darker in shade towards autumn.

Box Psyllid.

Psyllia buxi L.

This species is common in Europe and in the United States, though it has been entirely neglected in Crawford's monograph of the New World Psyllidae. It is very abundant in S.E. Scotland on box hedges, and in heavy infestations greatly detracts from the appearance of the plants. Economically it has very little importance, although control measures have been undertaken in Holland

and New Jersey, where box plants kept for ornamental purposes have been greatly disfigured by the insects. *Spanioneura fonscolombi* Förster, the only other species living on box, occurs in England, but was not found by me in this region. It is reported from Europe and the United States.

P. buxi was designated as the type of a new genus *Asphagidella*, erected by Enderlein (1921). This genus is differentiated from *Asphagis* (also created by Enderlein at the same time) by the absence of R_1 in the hind-wings. *Asphagis* itself is separated from *Psyllia* by the absence of a pterostigma, the thickening of the costa distal of R_1, and the development of R_1 as a vein in the hind-wing. Neither of these genera seems to be well founded, and it is very doubtful, especially in the case of *Asphagidella*, as pointed out by Ferris (1926), if the mere absence of a vein in the hind-wing, where veins are usually reduced or faintly developed, is sufficient to justify the formation of a new genus. In the present work, therefore, *Psyllia*, the old generic name of this species, is retained.

Specific Characters.

P. buxi may be distinguished from other closely allied species by the following characters :—

Antennae half the length of costa. Genal cones as long as vertex down the middle, pubescent, bluntly rounded, their divergence less than base of either. Wings with pterostigma absent, veins concolorous with elytra. " Genital segment of the female nearly as long as the remainder of the abdomen, both tergite and sternite beset with a longitudinal band of small, black, tubercle-like setae. Male with the anal valve moderately long and slender beset with numerous fine setae; claspers slender, terminating in a single small tooth on the inner side." (Ferris, 1926.)

Host.

P. buxi is known to breed and live on only *Buxus sempervirens*, the common box plant. Curiously enough Taylor (1901) emphatically stated that it occurred on " various garden plants but certainly not on box." Extensive observations have shown this remark to be entirely without foundation.

Life-history.

Adult. The adults appear towards the end of April and continue to live on box hedges till about the end of August. They are green robust insects, markedly broader towards the head than towards the abdomen, the female having a long pointed ovipositor. The entire life is passed on box, there being little dispersal of the insects to other plants at any time.

Mating starts in the beginning of August, and the method is very similar to that described for *Psyllia alni*. The time taken is usually not more than 20 minutes. Oviposition commences shortly afterwards and is completed in the last week of August, when the females die, the males dying a little earlier. After August no adults were found in the field.

Egg.

Length without stalk, ·35 mm. Greatest breadth, ·5 mm. Length of stalk, ·10 mm. Colour dull orange. Elongated oval, bluntly pointed distally, with a small stalk at basal end.

Eggs are laid singly in slits made in the axils of leaves and twigs by means of the long and sharply-pointed ovipositor, and, on this account, are very difficult to detect by a casual examination of the plant. Contrary to the observation of Hamilton (1926) and in spite of the host being an evergreen, on which adults might be capable of living, the egg stage lasts throughout the winter.

Nymph. The eggs hatch in early April, just when new leaf-buds are beginning to appear, and by the end of the first week large numbers of first-instar nymphs may be encountered in the field. The entire nymphal period takes about fifty days during which five moults occur, the last ecdysis preceding the adult stage. The duration of the different stadia was determined in the laboratory greenhouse to be, on an average, as follows :—

I	instar	6–8	days.
II	,,	6–8	,,
III	,,	8–10	,,
IV	,,	7–8	,,
V	,,	10	,,

Habits of the Nymphs and their effects on the Host.

Immediately after hatching the nymphs pass to the new leaf-buds, which are then just opening, and conceal themselves in the folds of the partially-opened leaves. It is remarkable how even the previous year's leaves are wholly neglected, although the nymphs have an equal choice of both the old and the new shoots. They may, therefore, be said to be negatively geotropic and positively thigmotropic. The nymphs are active when disturbed, and have each a globule of white secretion at their posterior end. This secretion does not markedly differ from that secreted by *Psyllia mali.* The curling of the leaves so characteristic of box plants infested by this Psyllid, starts when the insect is approaching the end of the second instar, and after some twelve days, when the nymphs are in the fourth stage, the cabbage-like appearance of the shoots is quite noticeable. Each of the galls is formed of three or four curled leaves and harbours from six to ten nymphs from the third stage onwards, secreting copiously.

Colouration of the Adult.

Like the majority of PSYLLIDAE, the colour of *P. buxi* changes with the advance of the season. The following forms occur typically in summer and autumn :—

Summer Form.

Head green, antennae light brown, tips of segments 4–8 and entire segments 9–10 black, eyes reddish-white, ocelli deep yellow. *Thorax* green with dull brown marking, elytra dusky, legs brown. *Abdomen* green, female genitalia brown in distal half, male anal valve yellow, forceps white.

Autumn Form.

Head white, antennae brown, last two segments black, eyes blackish-brown, ocelli deep orange. *Thorax* with dark brown markings, elytra dusky, legs dark brown. *Abdomen* blackish-brown, female genitalia brown, male anal valve dull white, forceps brownish distally.

Abnormality.

Although no cross-veins normally exist in the wings there appeared in the fore-wing of one specimen of *P. buxi* a cross-vein joining Rs with M at the point of its bifurcation into M_1 and M_2. An exactly similar case of a vein between Rs and M is recorded by Boselli (1931*b*) in *Spanioza cinnamomi* Boselli.

A number of other instances of abnormality in Psyllid wings are recorded by Frauenfeld (1867), who in his account of *Anisostropha ficus* gives figures of 23 fore-wings of the genera *Anisostropha*, *Trioza* and *Psyllia* showing various forms of abnormality in the veins. According to this author, the variations are most frequent in the genus *Psyllia* and very scarce in *Trioza*; further, they usually occur in one wing only and are seldom symmetrical. The abnormality is not confined to wings only, and Crawford (1920) records a case in which *Aphalara* (*Anomocera*) *anomala* Crawf. possessed nine-segmented antennae instead of the usual ten, and a supernumerary marginal cell in the fore-wings.

HAWTHORN PSYLLID.

Psyllia melanoneura Först.

Many species of PSYLLIDAE, all belonging to the genus *Psyllia*, have been recorded on hawthorn, but only two have been found in S.E. Scotland, *P. mali*, discussed in a separate paper (1934*b*), and *P. melanoneura*. This latter species can be distinguished from *P. mali* and other allied species by the following characters :—

Genal cones short, narrowly pointed in distal half, their divergence equal to or less than base of either, their outer edge sinuate, inner almost straight. Antennae less than half the length of costa. Female genitalia a little less than length of abdomen, not markedly pubescent, anal valve longer than subgenital, latter dark and sharply pointed at extremity. Male forceps shorter than anal valve, bent at base, distal extremity dark and rounded, spool at proximal end of spermatic duct short, anteriorly rounded and well expanded.

This species has two sets of seasonal host-plants, *Crataegus oxycantha* and other species of *Crataegus* in summer and early autumn, and various conifers, chiefly *Taxus baccata*, in late autumn and winter. Harrison (1915) recorded it from Clevelands as being common on oak and conifers late in the year, and Mokrzecki (1916) reported it as occurring on pear in Simferopol.

Economically *P. melanoneura* is of slight importance, having been recorded only once by Mokrzecki (*loc. cit.*) as injuring pear trees in Simferopol. According to the same author this insect had two generations in 1915, hibernated in the adult stage in groups on the trunks of pear trees, and oviposited during the first half of March on the branches. My observations in S.E. Scotland show an entirely different life-history, in which *P. melanoneura* has a single generation in the year and overwinters in the adult stage.

Life-history.

Adult. The adults first appear towards the end of May, and after the second week of June nymphs may no longer be found in the field. They are at first greenish, but about two days after emergence become reddish and are then easily distinguished from *P. mali*, which is rich green. They remain on hawthorn till about the middle of autumn, when with the approaching leaf-fall they migrate to neighbouring evergreen plants. In one locality under observation the winter was passed on *Taxus baccata* and other conifers, and in another, where there were no conifers at hand, on broom. This change of host is made only for food and shelter and not for oviposition. Observations made on *P. melanoneura* seem also to support McAtee's (1915) view, based on previous records of other species, that the habit of resorting to conifers is not restricted to the cold season.

About the middle of March there is a return migration to hawthorn, and the insects start mating. Oviposition begins 5 to 7 days later, after which the adult insects live for a considerable time, and it is only towards the end of April that they die and disappear in the field. There is thus an interval of only about five weeks between the overwintering adults of the first generation and those of the second or spring generation.

Six females and six males confined on hawthorn on 21.iii.33 laid 755 eggs in all, during a period of 20 days, *i.e.* an average of 156 eggs per female. At the time of oviposition the female becomes very sluggish and fails to respond by jumping even when repeatedly touched. The most noticeable habit of the female at this time is the secretion of long tubes of white waxy material, which issue from the circumanal pores.

Egg.

Length, ·32 mm. Greatest breadth, ·15 mm. Length of stalk, ·04 mm.
Broadly oval with a stalk at basal end. Colour deep yellow.

Eggs are laid in groups on the newly-opened leaves, chiefly on the under surface but sometimes on the upper. The largest number of eggs is inserted by the basal stalk near the midrib, but other parts of the leaf and rarely even the petioles may be selected. The number of eggs in a group varies from 2 to 15.

Hatching commences about two weeks after oviposition, and a few days before, the two red eyes of the embryo are visible through the chorion at the narrow distal end of the egg, the abdomen lying towards the basal extremity.

Nymph. The first-instar nymphs appear in the second week of April and have a life of about six weeks, during which they moult five times, the last ecdysis being followed by the adult stage. The duration of each stadium in the greenhouse was roughly as follows :—

I instar 8 days.
II ,, 7 ,,
III ,, 7 ,,
IV ,, 8 ,,
V ,, 12 ,,

Habits of Nymphs.

The first-instar nymphs feed gregariously for the first few days at the site of their emergence from the egg. Later, in the second and third instars, they move towards the growing shoots and cluster on the opening leaf-buds. In the last instar they may be met with anywhere on the leaf and live singly. The nymphs start secreting a white waxy substance in little droplets or ribbons about 12 to 20 hours after hatching. The secretory activity progressively increases with the age of the nymphs and is at its maximum in the last two instars.

Colouration of the Adult.

The typical summer and winter forms of *P. melanoneura* differ markedly from each other in colour; they are described below :—

Summer Form.

Head white with brownish-yellow marking, distal half of genal cones and first three segments of antennae brown, rest of antennae progressively black, eyes brownish, ocelli deep red. *Thorax* yellow with brown marking, pronotum grey, elytra pale yellow, veins and legs light brown. *Abdomen* yellowish-green, female genitalia in distal half, and male anal valve and forceps brown.

Winter Form.

Head yellow with dark brown marking, genal cones white in proximal, brown in distal half, eyes and antennae blackish-brown, ocelli deep red. *Thorax :* Pronotum yellow with black marking, rest of thorax and legs blackish-brown, elytra dusky, veins brown. *Abdomen* black, intersegmental margins yellowish-brown, female genitalia black, male blackish-brown.

PEAR PSYLLID.

Psyllia pyricola Först.

There is some confusion with regard to the number and identity of the species of PSYLLIDAE attacking pear, and the following have been recorded on this host in Europe and the United States :—

1. *Psyllia pyricola* Först.
2. *P. simulans* Först.
3. *P. pyri* Linn.
4. *P. pyrisuga* Först.
5. *P. hexastigma* Horvath.
6. *P. melanoneura* Först.
7. *P. mali* Schmidberger.

Of these the last two are entirely different from other pear Psyllids, and pear is not their chief food-plant. *P. hexastigma* occurs chiefly in Eastern Siberia and Japan. Of the remaining four *P. pyrisuga* is the largest species, and, unlike the other three, is without any dark marking on the wings. The first three have been variously treated as synonymous by Crawford (1914), as two species by Edwards (1896), or as three distinct species by Riley (1891). My observations confirm the fact of *P. pyricola* and *P. simulans* being the summer and winter forms respectively of one and the same species. It is also probable that *P. pyri* is identical with *P. pyricola*, with occasional very slight differences, probably due to geographical isolation, although it has been frequently reported as a separate species from various parts of Europe during the last two decades.

Although said to occur on apple at times, *P. pyricola* lives chiefly on pear and is a very serious pest of this tree in the United States and to a lesser extent in Europe. In the orchards where my observations were made, apple and pear trees were growing side by side, yet no *P. pyricola* was ever found on apple trees.

Life-history.

Psyllia pyricola in this region is trivoltine and the imago hibernates in winter. In the United States it has four broods in the year, which are not sharply divided. The allied species *P. pyrisuga* had one generation in 1913 and two in 1914 in Salgir, according to Mokrzecki and Bragina (1915), and the authors think that the number of broods depends on climatic conditions. In the same locality Mokrzecki (1913) reported *P. pyri* to have overwintered in the egg stage; but, in view of the fact that the eggs did not have stalks or filaments like those of *P. pyricola*, it is very probable that he was dealing with an entirely different species.

1*st Generation.* The hibernating adults emerge from the crevices of the bark early in March and start mating towards the end of that month. Oviposition commences 3 or 4 days after mating. Eggs are laid on the outer surfaces of the leaf-buds (*i.e.* the under surfaces of leaves) parallel to the long axes of the latter, singly but close together, though not exactly in groups as recorded by Bröcher (1926) for *P. pyrisuga.* In rare cases, they may be laid at the bases of leaf petioles or on the upper surface of the leaves along the midribs. The egg is white when first laid, gradually turning yellow. It is broadly oval, with a short stout stalk towards the proximal end which is embedded in the leaf tissue, and a long filament-like process at the distal end. Its measurements are : length, ·30 mm. ; greatest breadth, ·18 mm. ; basal stalk, ·06 mm. ; distal filament-like stalk, ·18 mm.

Hatching commences in 2 to 3 weeks' time, and the first nymphs appear in the third week of April. The entire nymphal life lasts for about five weeks, and during this time five moults take place. The duration of each stadium in midsummer was approximately determined to be as follows :—

I instar 9 days.
II ,, 7 ,,
III ,, 7 ,,
IV ,, 7 ,,
V ,, 9 ,,

2nd and 3rd Generations. The adults of the first generation appear at the end of May ; mating occurs shortly afterwards, and eggs of the second generation are laid about the middle of June in the grooves of the leaf petioles, usually parallel to their long axis, and scarcely any on the leaves. Hatching occurs about 10 days later, and the adults of the second generation appear towards the end of July. Eggs being again laid, the adults of the third generation appear about the third week of October. The generations are well defined, but some overlapping takes place and nymphs of several different stages may usually be found before the emergence of the adults. The last generation of adults hibernates in the crevices of the bark of the pear tree, and may sometimes be taken in the middle of winter.

Habits of the Nymphs.

The nymphs on hatching feed singly on the underside of leaves, often near midribs, and remain immersed in a drop of transparent but sticky liquid, which they start secreting about 20 hours after hatching. The greatest production of this secretion commences after the second moult, when a sooty mould develops, and the presence of the nymphs can only be detected by tiny patches of moist dark areas on the under surface of the leaves. Awati (1915) in England had this injurious fungus identified as *Cladosporium herbarium.* The nymphs are usually very sluggish, and, unlike those of *P. pyrisuga* described by Bröcher (1926), do not at any stage feed in colonies.

Specific Characters and Colouration of the Adult.

P. pyricola may be distinguished from allied species by the following set of characters, based mainly on the description of the adult by Crawford (1914) :—

Body length : Summer form, 1·6–1·9 mm. Winter form, 1·9–2·3 mm. Vertex about as long as broad, with two foveae, conspicuously emarginate in front at median line with anterior ocellus in emargination and genal cones about two-thirds as long as vertex, their divergence less than base of either, outer edge concave, inner straight, subacute at tips, pubescent. Legs slender, hind tibiae with basal spur very small or wanting. Male anal valve a little longer than forceps, sides subparallel, pubescent, forceps simple, rather acute at tips, tapering uniformly from base to tip. Female genitalia short, dorsal valve a little longer than ventral, both acute.

Summer Colouration.

General colour orange to reddish-brown with darker markings. Antennal segments 7–10 and apices of those of 4–7 black. Legs yellow except brown femora. Wings transparent with a slight yellowish tinge, specially in distal cells, with a conspicuous black patch at tip of clavus and another above it. Veins pale yellow.

Winter Colouration.

General colour reddish-brown with black markings. Antennae black. Legs brown except blackish-brown femora. "Elytra hyaline or lacteo-hyaline, the disc of the cells feebly and suffusedly fuscous, a broad fuscous stripe occupying almost the entire length of cell 1, apex of clavus blackish, veins blackish." (*Vide* Edwards, 1896, for *P. simulans.*)

THE WILLOW PSYLLID.

Psyllia ambigua Först.

(Subfamily PSYLLINAE.)

The following is a list of the species of PSYLLIDAE recorded as living on willows :—

Species.	Host. Genus *Salix*.	Locality.
1. *Psyllia ambigua* Först.	*S. caprea* and other species.	British Isles and Central Europe.
2. *P. salicicola* Först.	*S. caprea.*	,,
3. *P. brunneipennis* Edwards.	*S. pentandra.*	British Isles.
4. *P. americana minor* Crawf.	*S. rostrata.*	North America.
5. *P. iteophila* Löw.	*S. incana.*	Europe.
6. *P. klapaleki* Sulc.	*Salix* sp.	,,
7. *P. elegantula* Zett.	*S. caprea.*	,,
8. *P. parvipennis* Löw.	*S. rosmarinfolia.*	,,
9. *P. nigrita* Zett.	*S. purpurea.*	,,
10. *P. dudai* Sulc.	*Salix* sp.	,,
11. *P. ornata* Meyer Dur.	*Salix* sp.	,,
12. *P. abdominalis* Meyer Dur.	*Salix* sp.	,,
13. *P. ulmi* Först.	*S. caprea.*	,,
14. *Trioza salicivora* Reut.	*S. caprea.*	British Isles and Europe and Japan.
15. *T. albiventris* Först.	*S. purpurea.* *S. alba.* *S. fragilis.*	,,
16. *T. unifasciata* Löw.	*S. purpurea.*	,,
17. *T. striola* Flor.	*S. caprea.*	British Isles.
18. *T. varians* Crawf.	*Salix* sp.	North America.
19. *T. salicis* Mally.	*S. lasiolepis* and other species.	North America.
20. *T. maura* Först.	*S. alba, S. purpurea, S. lasiolepis.*	Europe and North America.
21. *Ceropsylla californica* Crawf.	*S. rostrata.*	North America.

In this region *P. ambigua* alone of the above species has been found by me, although it is possible that some of the other British species also occur. It is a noteworthy fact that *Salix* and *Citrus* are perhaps the only two genera among the host-plants of PSYLLIDAE which harbour species belonging to at least three genera and two subfamilies.

Economically, Psyllids do little injury to willows in the British Isles and the same may be said of them in the United States. They are, however, included by Willcocks (1922) in the list of pests of the willow in Egypt, and certain species are said to cause serious damage at times.

Specific Characters.

P. ambigua may be distinguished from other allied species by the following characters :—

Antennae scarcely half as long as costa. Genal cones slightly pubescent, about as long as crown down middle, their inner edge straight, outer concave, their divergence less than base of either. Male anal valve and forceps beset with setae, former broadest about middle, latter smaller and slender, each ending in a small brown claw. Female anal valve bluntly, subgenital sharply pointed, former longer than latter, both beset with setae. Anal porering three-layered anteriorly.

Life-history.

P. ambigua has one generation in the year, and the adults hibernate.

Adult. The adult insects appear towards the end of May and continue to live practically all the year round. Near the end of autumn migration to other plants ensues, and in winter the leafless willow is free from the Psyllids. In an area kept under observation, the cold season was passed on broom bushes, from which adults were collected in January and February. A little before the approach of spring there is a return migration to the willow, just when the leaf-buds are beginning to burst, and in the last week of March the insects begin mating. The method is the same as that described for *P. alni.* Oviposition commences 4 to 6 days after mating and continues for about three weeks. Immediately before laying the female becomes fluffy and extremely sluggish; the antennae vibrate, and the ovipositor is curved at the base, its tip being inserted into the leaf tissue a moment later. One female was observed in the act of oviposition at the same spot for 1 hour 40 minutes.

Three males and three females, while still mating, were confined on a willow twig and in 22 days' time laid 468 eggs, *i.e.* an average of 156 eggs each.

Egg.

Length without stalks, ·38 mm. Greatest breadth, ·20 mm. Proximal stalk, ·07 mm. Distal stalk, ·05 mm.

Oval with a stalk at each end. Colour pale yellow when first laid, turning deep orange later.

Eggs are laid in irregular groups, as many as 40 together, on the half-opened leaf-buds, or on the under surface of leaves, rarely they are inserted in the tender green twigs.

Nymph. Hatching started in the second week of April in the greenhouse and a few days later in the field. The nymphal life continues till the third week of May, and during this period of about 40 days five moults occur, the last being followed by the adult stage. The period of each nymphal instar was determined in the greenhouse to be as follows :—

I	instar	12	days.
II	,,	8	,,
III	,,	9	,,
IV	,,	5	,,
V	,,	10	,,

Habits of the Nymphs.

The newly-hatched nymphs creep in between the folds of the opening leaf-buds and lie with their mouth-parts buried in the tissue till they are exposed by the fully-opened leaves. Even then they have a thigmotropic tendency to move towards leaf-bases in between the axils. The nymphs are definitely gregarious in the first two instars, in the third instar they are less so, while in the last two instars they occur singly. There is usually very little secretion; sometimes, however, little white waxy droplets exude from the apices of the abdomen, but there is no marked period of secretory activity, such as is noticed in some allied species like *Psyllia mali.*

Unusual Appearance of Nymphs.

Nymphs of the second and third stage were found in the third week of March. These were concealed in the spaces between the stem and the leaf-buds, and a slight waxy secretion was noticeable. Extensive search showed no trace of eggs on the plants. A number of female adults captured on 13.i.33, and dissected the same day, showed no development of the ovary. The early appearance of the nymphs may, however, be attributed to an occasional deposition of eggs at the end of autumn, which may hatch earlier than spring. The other possibility that the nymphs hatching before winter hibernate, to appear again in March, seems remote.

Colouration of the Adult.

P. ambigua in summer is a light green insect, while in winter it is dark brown. The typical colouration of the two forms is as follows :—

Summer Form.

Head and *thorax* yellowish-green with brown marking. Eyes brown, ocelli orange. Antennae brown, segments 4–8 progressively black. Elytra pale yellow with veins brown; legs brownish-yellow. *Abdomen* yellowish-green, female genitalia brown in distal third, male genitalia yellowish-green, tips of forceps brown.

Winter Form.

Head and *thorax* dull white, heavily marked with deep brown. Eyes and first six antennal segments deep brown, last four black, ocelli reddish-brown. Elytra dusky with veins deep brown, legs brown. *Abdomen* including male and female genitalia blackish-brown.

(Subfamily Triozinae.)

The Nettle Psyllid.

Trioza urticae L.

This species is the only representative of the subfamily Triozinae found by me in S.E. Scotland; nevertheless it is very common and heavily infests stinging nettle *Urtica dioica*, its sole food-plant in many parts. Like many other species of the genus it is said by Pape (1921) to form harmful leaf-galls on nettles in Germany, a fact not borne out by my observations in Scotland. Economically *T. urticae* is of no importance, though many other species of the genus are serious pests.

It is interesting to compare the genus *Trioza* with the genus *Psyllia* of the subfamily PSYLLINAE. Both belong mainly to the North Temperate regions, having a large number of species with distinctions, amongst some of them, very obscure. Both contain some serious pests, e.g. *T. merwei* Petty, *T. citei* Laing, *P. mali* Schmidberger, *P. pyricola* Först. Many species of *Trioza* form galls on their hosts, have usually three or four generations in the year and almost always overwinter in the adult stage; while in *Psyllia* very few species form galls, there is in many cases a single generation in the year and overwintering occurs in the egg, as well as in the adult, stage.

Life-history.

T. urticae has four overlapping generations in the year and winter is passed in the adult, and possibly in the nymphal, stage. The only evidence for the latter statement is the presence of the last-instar nymphs as late as the end of the year on old nettle plants in England, from which it is considered probable that at least some of the adults emerge at the approach of the spring. The former may be found all the year round except for a short period after the first batch of spring eggs is laid. They overwinter on any convenient green plants, box, holly, but preferably conifers and sometimes on the moribund stumps of the old nettle. Records show that the habit of overwintering on conifers, if available, is fairly widespread in PSYLLIDAE (McAtee 1915, Peterson 1923).

Adult. The adults emerge from their retreats about the middle of April, when the nettle comes into leaf, mate and start laying eggs about 5 or 6 days later. At the time of oviposition the female is very sluggish and refuses to jump even when repeatedly disturbed. The egg-laying period lasts over a month in captivity, after which both the males and females die. Three females confined with three males on a nettle plant on 24.iv.33 had deposited 529 eggs in all at the end of 34 days, *i.e.* an average of 176 eggs per female. The average seems to fluctuate widely in different species of *Trioza*; it is said to be 611 in the case of *T. merwei* by Van der Merwe (1923) and 93·5 according to Peterson (1923) in the case of *Trioza tripunctata* Fitch.

Egg.

Length, ·30 mm. Greatest breadth, ·17 mm. Basal stalk, ·05 mm. Distal stalk, ·12 mm.

Oval, broad at base with a stout stalk, sharply-pointed distally, ending in a long tapering stalk. White when first laid; becoming yellow later.

Eggs are scattered irregularly on the under surface, rarely on the upper surface, of the leaves, with the basal stalk inserted in the leaf tissue. The incubation period is about 10 days in spring and summer and about two weeks in autumn. A day or two before hatching the two red eyes of the embryo appear towards the distal end of the egg.

Nymph. In the greenhouse the first-instar nymphs appeared on 10.v.33, and after an interval of about 5 weeks the adults appeared. During this period 5 moults occur. Rudimentary wing-pads become visible after the first moult and the adult emerges after the fifth. As in most other PSYLLIDAE, moulting occurs by a longitudinal dorsal slit in the cephalo-thoracic region.

Subsequent Generations.

The first generation of adults, appearing about the middle of June, mate and start laying eggs a week later. As the warm season advances the life-cycle becomes shorter, and by the end of July a large number of eggs of the second generation are laid. After this it becomes very difficult to define the generations, but from the periodical abundance of eggs and adults in the field as well as in the greenhouse, it is believed that two further generations occur. The last generation takes longer to complete its life-cycle than the previous ones, and the adults, with possibly some of the last-instar nymphs of the fourth brood, overwinter. As pointed out before, there is considerable overlapping of generations and all stages of the insect may be found throughout the summer and early autumn. After the end of September, only advanced nymphs and adults are found.

Habits of the Nymphs and Adults.

The nymphs on hatching attach themselves to the leaf surface and feed singly. In heavy infestations as many as 20 or more nymphs may be found on a single leaf. They are extremely sluggish and seldom move. About 2 days after hatching they produce a regular series of long flat waxen shafts, each arising at the bases of the secta-setae and enclosing them entirely. These shafts are very fragile and are secreted in two or three instalments as evidenced by nodes in their lengths. Their production continues till the end of nymphal life and in later stages their length is often greater than the length of the whole body. The secretion of these flat waxen shafts is a common feature of many nymphs of the subfamily TRIOZINAE and of some species of the genus *Psyllopsis.* In addition, in the last three instars, small white pellets of waxy substance are also secreted from the apices of the abdomen, but there is no formation of a continuous ribbon or tube from the circumanal pores as reported in *Trioza tripunctata* by Peterson (1923). The adults also secrete white pellets of waxy substance.

Colouration of the Adults.

Although there is no marked seasonal variation in colour *T. urticae* assumes many different hues which may be described thus :—

Vertex and thorax white to yellow, with brown or dark brown marking. Genal cones darker in distal two-thirds, whitish in proximal one-third. Antennae entirely dark or only the distal two-thirds, rest yellow to brown. Wings with a dusky tinge, veins brown. Legs and abdomen yellowish to deep brown.

(Subfamily LIVIINAE.)

THE WILLOW HERB PSYLLID.

Aphalara nebulosa Zett.

This species is of no economic importance, but is interesting chiefly because of its passing the autumn and winter in the nymphal stage. This habit is rare in Psyllids, the only other authentic case of seasonal nymphal dormancy being that recorded by Boselli (1930), in which nymphs of *Spanioza* (*Trioza*) *galii aspinovelutina* Sulc. aestivate in summer during the resting period of their host, *Rubia peregrina. Aphalara nebulosa* is also the only representative of the subfamily LIVIINAE found by me in this region, where its sole host is

Epilobium angustifolium, although it is also reported as living on *E. gessneri* in various parts of Europe and Japan.

Life-history.

Adult. The adults appear about the middle of May and may be found in the field till the end of June. Mating occurs about a week after emergence and eggs may be laid from 6 to 10 days afterwards. It was early discovered that the ratio of the males emerging after the last nymphal ecdysis was greater than that of females, and this was substantiated by occasional counts of the insects captured at random in the field. Some of these figures are given below :—

Sex ratio of Adults of *A. nebulosa* taken in the Field.

Taken on . . .	3.vi.32	8.vi.32	9.vi.32	15.vi.32	16.vi.32	29.vi.32	7.vii.32
Males . . .	49	20	16	6	28	75	7
Females . . .	33	17	9	5	16	34	14

This disparity in the number of the sexes of these insects is reflected in the manner of their mating. Although only one male and one female are actually concerned in the process, usually there are two and sometimes three males attached to each female at the time of copulation. As the insects at this time are very sluggish, it is easy to watch them, on a leaf-blade, under the binocular. The following description is drawn from actual observation :—

A number of males are seen to attend a female and finally two approach her. The elytra of the latter is then partly covered by the adjacent elytra of either male, one on each side, the heads of all the three insects pointing in the same direction. Soon after, the aedeagus of one of the males is inserted into the genital opening of the female exposed by the forceps of the former, which pushes apart the anal and subgenital valves of the latter. The other male remains close to the body of the female with the apex of its abdomen attached to the ventral surface of the latter. Sometimes a pair was seen to be mating, when a third male arrived and attached itself to the female. Copulation may last, with an additional male in attendance, for about 50 minutes.

Egg.

Length, ·32 mm. Greatest breadth, ·16 mm. Basal stalk, ·06 mm. Distal stalk, ·07 mm.

Oval, somewhat pointed at both ends, each end with a stalk, of which the basal is inserted in the leaf tissue. Colour white when first laid, turning yellow in a few days.

Eggs are deposited in linear arrangement at the edges of the leaves on the under surface, the edges turning backwards and enclosing the eggs in flat sheaths. Seven to ninety-seven eggs were counted in such sheaths. Sometimes they were not exactly linear in position but scattered irregularly. Eggs may be laid on both margins of a leaf.

Hatching occurs towards the end of June, about 10 days after oviposition. Three to five minutes before hatching there is slight movement inside the egg, and, soon after, the shell ruptures abruptly with a snap on the dorsal side of the nymphs, along a transparent longitudinal streak which is noticed about 10 hours before hatching. After 1 to 1½ minutes' rest the nymph starts pushing its head forwards in an effort to free itself from the egg-shell, which is still covering it ventrally and laterally. After the body is freed the egg-shell becomes a crumpled transparent mass. The whole process of hatching until the nymphs moves away takes from 10 to 15 minutes.

All the eggs in a leaf sheath do not hatch on the same day.

Nymph. The nymphs remain in the sheath for 3 or 4 days after which they move to the under surface of the leaves, and feed singly. No secretion appears till the third day after hatching and in about 10 hours the rate of its production is greatly increased. A few days later, about the end of July, these first-instar nymphs begin to disappear from the leaves, and from August no apparent trace of *Aphalara nebulosa* in any of its stages is found on the exposed parts of its host. As the nymphs do not migrate to neighbouring plants it was surmised that they had descended to the roots in the soil. This proved to be the case, as was shown by scraping the soil from the roots of willow-herb over a white sheet of paper, when many living second-instar nymphs were found attached to them. These nymphs secrete very little waxy substance from the circumanal pores, but waxy, shaft-like, structures are often secreted from the bases of the dagger-shaped setae surrounding the body margin, the shafts enclosing the setae completely. The nymphs in this stage have small but well-developed wing-pads and obviously a moult occurs soon after they arrive at the roots. It is believed that one or possibly two further moults occur, and winter is passed actually in the third or fourth stage. These premises are confirmed by the fact that early in April, when fresh shoots are sprouting up from the previous year's rootstock of the willow herb, nymphs of the last two stages are found clustering amongst the roots and on the half-opened leaf-buds. At this time there is no trace of egg or adult. The nymphs continue to increase in abundance as bud after bud opens on the plant, and there seems to be perfect synchronisation between the appearance of the two.

These advanced nymphs are always found in the top shoots, clustered together between the folds of the half-opened leaves. They are therefore gregarious in the last two instars and positively thigmotropic. A white waxy secretion also exudes from the circumanal pores in the form of little ribbons or masses. The nymphs are very sluggish.

Colouration of the Adult.

Unlike many other Psyllids there is no seasonal change in the colouration of the adult. Immediately after emergence the insect is pale yellow and transparent, but soon the brown hue of the typical adult is assumed.

Inquilines.

Two other insects, a Capsid nymph and a thrips larva, were often found in the leaf-sheaths in association with the first-instar nymphs. These are believed to be inquilines.

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EXPLANATION OF PLATES XI–XIV.

PLATE XI.

A. Male genitalia of *Psyllia buxi* L.
B. Female genitalia of *P. alni* L.
C. Portion of circumanal pore-ring.
D. Female genitalia of *P. försteri* Flor.
E. Portion of circumanal pore-ring.
F. Female genitalia of *P. buxi.*
G. Cephalic aspect of head of *P. buxi.*
H. Antennae of *P. buxi.*
I. Male genitalia of *P. försteri.*
J. Male genitalia of *P. alni.*
K. Tip of forceps of *P. alni.*
L. Tip of forceps of *P. försteri.*
M. Egg of *P. alni.*
N. Egg of *P. försteri.*
O. Egg of *Aphalara nebulosa* Zett.
P. Egg of *Psyllia buxi.*
Q. Egg of *Trioza urticae* L.
R. Fore-wing of *P. buxi,* showing abnormal cross-vein between *Rs* and *M.*

PLATE XII.

A. Cephalic aspect of the head of *Psyllia ambigua* Först.
B. Male genitalia of *P. ambigua.*
C. Female genitalia of *P. ambigua.*
D. Cephalic aspect of the head of *P. melanoneura* Först.
E. Antenna of *P. melanoneura.*
F. Male genitalia of *P. melanoneura.*
G. Female genitalia of *P. melanoneura.*
H. Egg of *P. pyricola* Först.
I. Male genitalia of *P. pyricola.*
J. Cephalic aspect of the head of *P. pyricola.*
K. Female genitalia of *P. pyricola.*
L. Egg of *P. ambigua.*
M. Egg of *P. melanoneura.*
N. Egg of *Psyllopsis discrepans* Flor.
O. Egg of *P. fraxinicola* Först.
P. Male genitalia of *P. fraxini* L.
Q. Male genitalia of *P. discrepans.*
R. Male genitalia of *P. fraxinicola.*
S. Female genitalia of *P. fraxinicola.*

PLATE XIII.

A. Photomicrograph of a fifth-stage nymph of *Trioza urticae* L. showing long shafts of white waxy secretion arising at the bases of the secta-setae surrounding the body margin.

B. Photomicrograph of a second-stage nymph of *Psyllopsis fraxinicola* Först. showing some of the long shafts of white waxy secretion arising at the bases of the lanceolate setae surrounding the abdominal and the costal margins (uppermost in the figure).

C. Portion of an ash plant showing the characteristic curling of the leaves and the formation of copper-coloured galls by the nymphs of *Psyllopsis fraxinicola* Först. and *P. discrepans* Flor. The commencement of the process is seen on the two leaves at the bottom left, and the fully-formed galls in the centre, towards the left. The small white patches on the leaves indicate the presence of the nymphs surrounded by their secretion of white fluffy, silky material.

D. Leaves of willow-herb, *Epilobium angustifolium*, showing the sheaths formed at the edges as a result of the laying of eggs by *Aphalara nebulosa* Zett.

PLATE XIV.

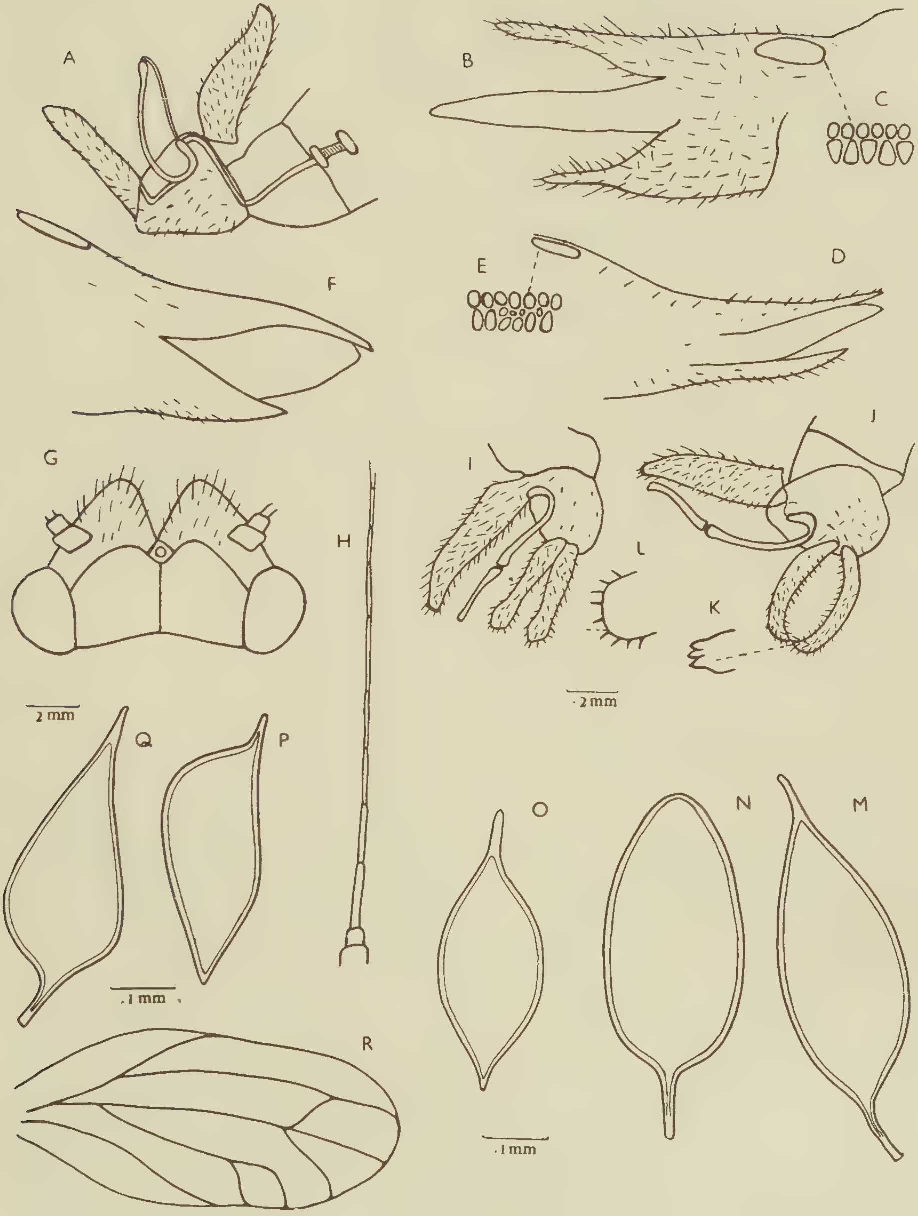
Parts of the body of a psyllid. (Referring principally to species of the subfamily PSYLLINAE.) Semi-diagrammatic.

A. Lateral aspect of mouth-parts.
B. Dorsum of thorax.
C. Cephalic aspect of head.
D. Hind-wing.
E. Terminal segments of male abdomen.
F. Fore-wing.
G. Female genitalia.
H. Ovipositor.

LETTERING.

A.	anal vein.
a.	anal aperture.
ad.	aedeagus.
ant.	antenna.
ap.	anal pore-ring.
av.	anal valve.
axc^1.	axillary cord of mesoscutellum.
axc^2.	axillary cord of metascutellum.
cly.	clypeus.
cr.	crescent-shaped structure at the end of dorso-lateral rod.
Cu.	cubital vein.
dlr.	dorso-lateral rod.
dmp.	dorsal median plate.
dor.	dorsulum.
e.	eye.
eg.	egg passing through the tunnel of the ovipositor.
f.	forceps.
fav.	female anal valve.
fr.	frons.
fs.	fan-shaped expansion of the distal portion of the dorso-lateral rod.
gc.	genal cone.
l^2.	second labial segment.
l^3.	third labial segment.
labr.	labrum.
lp.	sclerotised loop in connection with the ejaculatory duct.
M.	Median vein.
man.	mandibular stylet.
max.	maxillary stylet.
msct^1.	mesoscutellum.
msct^2.	metascutellum.
oc.	ocellus.
pro.	pronotum.
ps^1.	post-scutellum of mesothorax.
ps^2.	post-scutellum of metathorax.
R.	Radial vein.
Rs.	Radial sector (vein).
sbg.	subgenital valve.
sc^1.	scutum.
sc^2.	metanotum.
sp.	spool (sclerotised and striated anterior extremity of ejaculatory duct).
stg.	stigma.
v.	vertex.
vr.	ventral rod.

Plate XI.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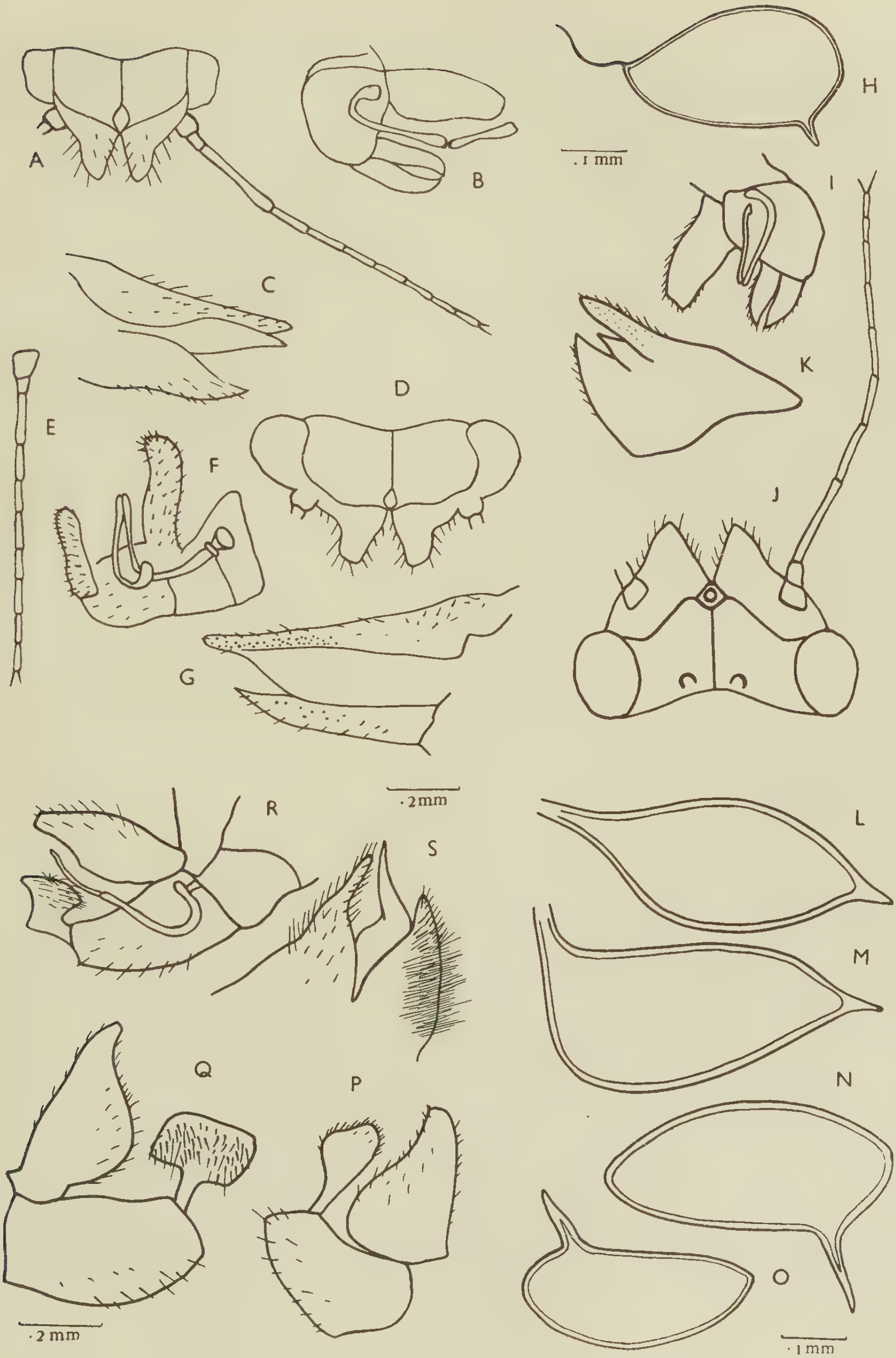
The Biology of Scottish Psyllidae.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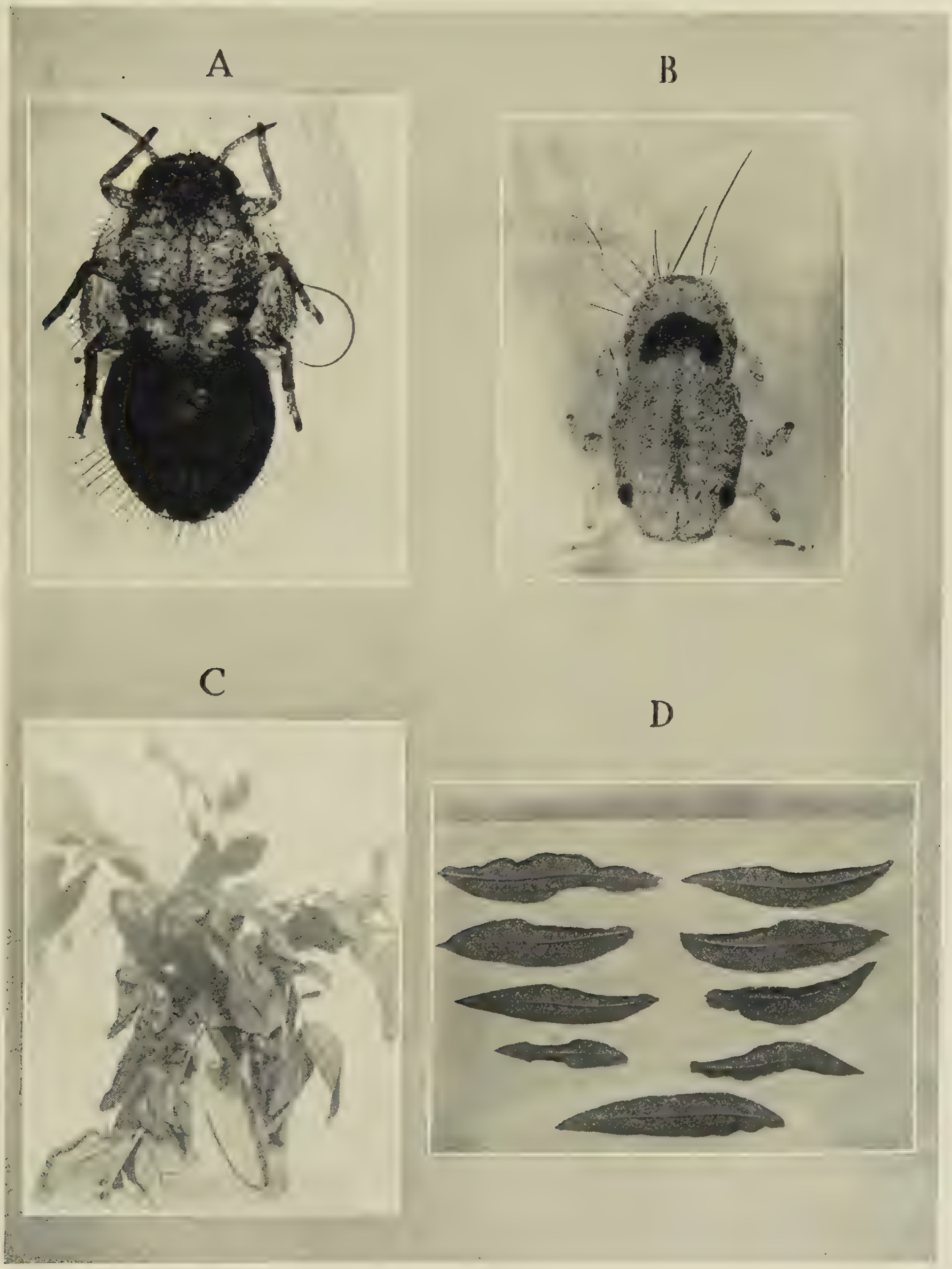

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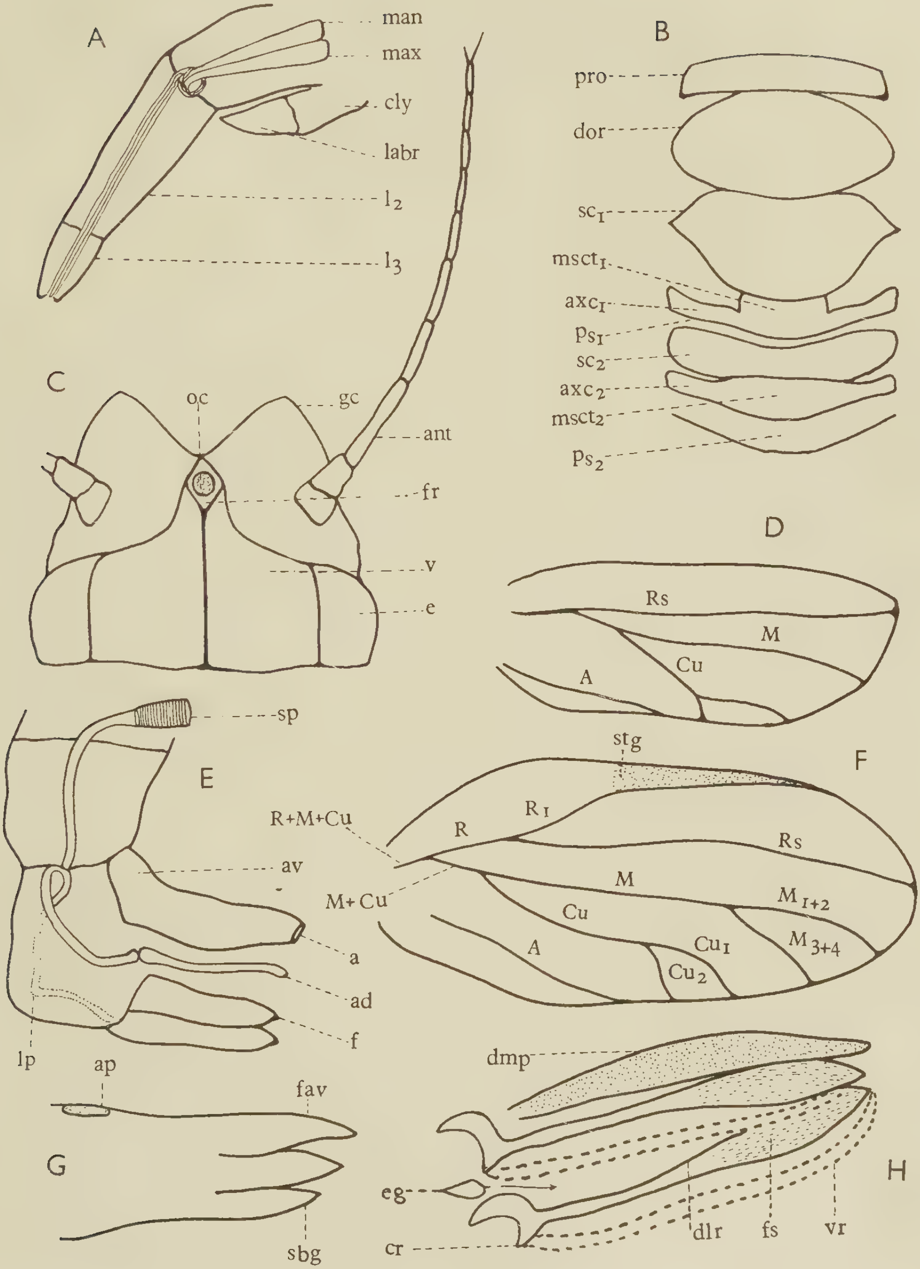
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The Biology of Scottish Psyllidae.

T.tle cat Au

ÜBERSICHT DER ORIENTALISCHEN GATTUNGEN UND ARTEN DES *CARCELIA*-KOMPLEXES (DIPTERA : TACHINIDAE)

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[Read 4th April, 1934.]

(Communicated by Miss D. Aubertin.)

Nach meiner Bearbeitung der formosanischen Carcelien aus dem Deutschen Entomologischen Institut in Berlin-Dahlem (*Sauters* Formosa-Ausbeute) im Jahre 1931, lernte ich noch anderes, umfangreiches Material aus den verschiedensten Lokalitäten der orientalischen Region kennen. Und da ich noch viele neue Arten absondern und die Arten des *Carcelia*-Komplexes zu engeren Artengruppen verbinden konnte, halte ich es für zweckmässig, eine Übersicht der mir bekannten orientalischen *Carcelia*-ähnlichen Raupenfliegen (*Carcelia*-Komplex) zu geben. Die erwähnten engeren Artengruppen fasse ich als besondere Gattungen auf und zwar aus zwei Gründen : Erstens erleichtert eine Teilung der alten Gattung *Carcelia* R.D., die Übersicht der zahlreichen und in mancher Hinsicht heterogenen Arten und zweitens folge ich hierin Townsend, welcher bereits die Gattung *Carcelia* zu teilen begonnen hat und dessen neue Gattungen in den meisten Fällen wohlbegründet sind.

Unter Berücksichtigung, dass die Carcelien wichtige Parasiten vieler schädlicher Lepidopterenraupen sind, und sich daher nicht nur Tachinenspezialisten mit ihnen befassen, sondern auch vielfach praktisch arbeitende Landwirtschafts- und Forstentomologen, trachtete ich, die Bestimmung der Carcelien soweit als möglich zu erleichtern, indem ich meine Bestimmungstabelle vorwiegend nach leicht zugänglichen äusseren Merkmalen zusammen zu stellen versuchte. Manchmal wird jedoch eine Freilegung des Hypopygiums oder wenigstens des Forceps ratsam, oft auch unerlässlich sein. In solchen Fällen sollen die dieser Arbeit beigefügten schematischen Zeichnungen des Forceps mit den Paraloben als Wegweiser zur Identifizierung der Arten dienen. Auch in meiner oben genannten Arbeit befinden sich mehrere Hypopygiumabbildungen, welche manche Zweifel bezüglich der Artzugehörigkeit lösen können.

Das Material, welches vorliegender Arbeit zugrunde liegt, stammt zum grössten Teil aus den Tachinidensendungen, die ich von folgenden Instituten, resp. Museen zum Bestimmen erhielt : Imperial Institute of Entomology in London, British Museum in London, Deutsches Entomologisches Institut in Berlin-Dahlem, Instituut voor Plantenziekten in Buitenzorg, Museen in Buitenzorg, München und Stettin. Von besonderem Interesse waren für mich die Carcelien aus dem British Museum, da ich unter ihnen Arten mit ganz neuen Lokalitäten fand, so z.B. *Carcelia rasa* Macq. aus Burma und *Eucarcelia excisa* Fall. von Ceylon. Wissenschaftlich wertvoll war auch das Material des Imperial Institute of Entomology ; es enthielt nämlich zahlreiche gezüchtete Raupenfliegen mit genauer Angabe von Wirt, Lokalität und Datum. Die

Fliegen aus Berlin-Dahlem gehören zum grössten Teil der bekannten Formosa-Ausbeute Sauters an; auch unter dem Material des Stettiner Museums fand ich viele von Sauter gesammelte formosanische Larvaevoriden. Von letztgenanntem Museum erhielt ich ausser dem gewöhnlichen musealen Material eine Schachtel mit fast ganz ruinierten Tachinen, welche mir zu morphologischen Studien gänzlich zur Verfügung gestellt wurden. Unter diesem wertlos erscheinenden Material fand ich unerwartet vieles Neue und manches Aufschlussgebende. An dieser Stelle möchte ich nun den Leitern genannter Institute und Museen für die Zusendung dieses wertvollen Materiales meinen wärmsten Dank aussprechen. Auch den Leitern des Zoologischen Museums in Amsterdam bin ich zu Dank verpflichtet, da ich es deren Entgegenkommen verdanke, dass ich viele der Townsend'schen Typen von Sumatra studieren und auf diese Weise so manche Synonymie aufklären konnte, was allein auf Grund seiner Diagnosen nicht möglich gewesen wäre.

In den *Carcelia*-Komplex beziehe ich alle Eutachinen der " categorie A " Villeneuves (26) *—jedoch ohne Berücksichtigung der Einteilung in " monocanthes " und " polyacanthes," Villeneuve (27)—welche sich von den zunächst stehenden Gattungen durch folgende Merkmale unterscheiden : Augen behaart, Männchen ohne proklinate Orbitalborsten, Hinterkopf ohne Börstchenreihe hinter den Postokularcilien. Reklinate Frontalborsten gut differenziert. Wangen und Backen schmal, Facialien nackt oder nur im unteren Drittel fein beborstet; Augen hoch und schmal, von vorne betrachtet mit fast parallelen oder gegen die Stirne nur wenig konvergierenden Innenrändern (für diesen Komplex ist dies meiner Ansicht nach das phylogenetisch wichtigste Merkmal). Mundrand höher als der Unterrand der Augen liegend, nur ausnahmsweise sich in der gleichen Höhe mit diesem befindend. Immer 2 Sternopleuralborsten vorhanden. Schildchen nur mit 1 Lateralborste. Flügel mit offener 1. Hinterrandzelle; Beugungsstelle der Medialader ohne Anhang; 3. Längsader nur basal beborstet, die übrigen Adern nackt. Hintertibien aussen vorne dicht bewimpert, mit oder ohne längere Borste in der Mitte; nur selten fehlt die echte Bewimperung, an deren Stelle dann eine Borstenreihe tritt.

Was nun meine Terminologie betrifft, so ist sie die für die Larvaevoriden übliche und es wäre nur einiges zu erläutern : " Sturmiafleck " nenne ich die kurze und dichte schwarze Behaarung, welche einen dunklen Fleck auf der ventralen Seite des 4. Abdominaltergites bildet; unter " Haarkleid " verstehe ich jene kürzere oder längere Behaarung, mit welcher das Abdomen ausser den echten Makrochäten bedeckt ist; das erste sichtbare Abdominalsegment nenne ich stets das zweite, mit Rücksicht darauf, dass es mit dem ersten verwachsen ist.

Im Ganzen unterscheide ich für die paläarktische und orientalische Region 15 Gattungen : 3 Gattungen für die paläarktischen Arten, 9 für die orientalischen und nur 3 Gattungen, welche Vertreter beider Regionen in sich vereinigen. Dies sind die Gattungen *Eucarcelia*, mit der in beiden Regionen weit verbreiteten Art *excisa* und der Art *kockiana*, welche aus der orientalische Region in die mandschurische Subregion der paläarktischen Region vordringt, —*Carcelia* s.str. mit der Art *rasella*, welche aus Europa aber auch von Formosa bekannt ist, und der Art *rasa*, welche in Europa sehr gemein ist und aus der orientalischen Region mir von den N. Chin Hills, 5,500 ft., in Burma und vom Berge Idjen, 1400 m, auf Java bekannt geworden ist,—*Parexorista*, welche zwar keine gemeinsame Art besitzt, jedoch durch besondere Arten in beiden Regionen vertreten ist. Mithin haben wir nur eine Art—*excisa*—welche in beiden Regionen weit verbreitet ist, und ich glaube, dass sie es verdienen würde einer gründlicheren Untersuchung unterzogen zu werden, wobei nicht nur die äussere Morphologie zu berücksichtigen wäre, sondern auch die anderen Faktoren, wie die verschiedenen Entwicklungsstadien, ihre Wirte, die Termalkonstante, Ökologie u.s.w.

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* Um ein und dasselbe Zitat nicht mehrmals schreiben zu müssen, was auch nicht übersichtlich wäre, führe ich jeweils nur den Namen des betreffenden Autors an und die Ziffer in der Klammer daneben gibt an, unter welcher laufenden Nummer des Literaturverzeichnisses dessen betreffende Arbeit angeführt ist.

BESTIMMUNGSTABELLE DER GATTUNGEN UND ARTEN.*

1 (2, 3). Thoraxrücken mit 3 postsuturalen Dorsozentralborsten (in der Regel). Der letzte Abschnitt der Medialader gleich lang oder fast gleich lang wie die Spitzenquerader. Haarkleid des Abdomens nicht dicht, borstig. Abdomen ohne Diskalborsten. Mittelschienen innen in der Mitte ohne Borste. Hinterhüften ohne Börstchen. Klauen des Männchens sehr lang. Hinterschienen aussen vorn mit einer Borstenreihe, welche aus weniger zahlreichen Borsten besteht . . . . *Catacarcelia* Towns.

1(2). Körperbereifung dicht, auf dem Dorsum deutlich gelblich *kockiana* Towns.
2(1). Körperbereifung spärlich, rein weiss . . . . . *rondaniella* sp. n.

2 (1, 3). Thoraxrücken mit 3 postsuturalen Dorsozentralborsten. Der letzte Abschnitt der Medialader beträchtlich kürzer als die Spitzenquerader. Mittelschienen innen in der Mitte ohne Borste. Hinterhüften hinten ohne Börstchen. Paläarktisch **Tricarcelia** gen. n.
Gatt.-Type : *Exorista susurrans* Rondani 1859.
3 (1, 2). Thoraxrücken mit 4 postsuturalen Dorsozentralborsten. Der letzte Abschnitt der Medialader beträchtlich kürzer als die Spitzenquerader.
4 (13). Mittelschienen innen in der Mitte ohne Borste.
5 (10). Klauen des Männchens sehr lang.
6 (7). Hinterhüften hinten ohne Börstchen. Haarkleid des Abdomens mit oder ohne Diskalborsten . . . . *Eucarcelia* gen. n.

1 (4). Abdomen rötlich mit schwarzer Längsstrieme und schwarzer Spitze. Abdomenbereifung undeutlich.
2 (3). Beine schwarz . . . . *sumatrana* (Towns.).
3 (2). Beine rot . . . . *rufa* (Bar.).
4 (1). Abdomen schwarz, nur zuweilen an den Seiten rötlich durchscheinend.
5(12). Abdomen dicht und mehr einfarbig bereift, zuweilen nur mit schmalen schwarzen Apikalbinden auf den Tergiten (bei *grossa*).
6 (7). Vordere Schienen hinten mit 1 oder 2 Borsten. Abdomen mit schmalen schwarzen Apikalbinden, jedoch der gesamte Habitus wie bei den anderen Arten dieser Gruppe *grossa* sp. n.
7 (6). Vordere Schienen hinten immer nur mit 1 Borste. Abdomen immer dicht und einfarbig bereift.
8 (9). Schienen hellrot . . . . *excisa* (Fall.).
9 (8). Schienen dunkelrot.
10(11). Orbiten und Wangen goldig . . . . . *dammermani* sp. n.
11(10). Orbiten und Wangen weisslich . . . . *indica* sp. n.
12 (5). Abdomen mit scharf begrenzten schwarzen Apikalbinden.
13(14). Nur 1 reklinate Frontalborste . . . . *prima* (Bar.).

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* Die Bestimmungstabelle, sowie die Diagnosen beziehen sich, wenn nichts anderes angegeben ist, auf die Männchen.

14(13). 2 reklinate Frontalborsten.
15(16). Kleine Art, Abdomen mit borstigem Haarkleid . . *quinta* (Bar.).
16(15). Grössere Arten, Abdomen mit haarigem Haarkleid.
17(18). Schienen schwarz . . . . *kockiana* (Towns.).*
18(17). Schienen dunkelbraun.
19(20). Apikalbinden der Abdominaltergite weniger scharf begrenzt, Körperbereifung ausgesprochen goldig . . . *secunda* (Bar.).
20(19). Apikalbinden der Abdominaltergite scharf begrenzt, Körperbereifung dünkler, mehr bräunlich . . . . . . *quarta* (Bar.).

7 (6). Hinterhüften hinten mit Börstchen.
8 (9). Ozellarborsten vorhanden. Drittes Fühlerglied länger als die vierfache Länge des zweiten. Haarkleid des Abdomens fein. Diskalborsten fehlend . . . . *Myxocarcelia* gen. n.

1(2). Abdomen rot mit schwarzer Längsstrieme und schwarzer Spitze *aberrans* (Bar.).
2(1). Abdomen schwarz mit weisslichgrauen Basalbinden und schwarzen Apikalbinden . . . . *hirsuta* (Bar.).

9 (8). Ozellarborsten fehlend. Drittes Fühlerglied ungefähr nur dreimal so lang wie das zweite. Haarkleid des Abdomens fein. Diskalborsten fehlend . . . . *Carceliella* gen. n.
10 (5). Klauen des Männchens kurz.
11 (12). Hinterhüften hinten ohne Börstchen. Haarkleid des Abdomens mehr oder weniger fein. Ohne Diskalborsten . . *Eocarcelia* Towns.

1(2). Orbiten und Wangen gelblich schimmernd. Körperbereifung goldgelb . . . . *aurata* (Towns.).
2(1). Orbiten und Wangen weisslich oder kaum gelblich. Körperbereifung weisslichgrau, zuweilen etwas gelblich *ceylanica* (Towns.).

12 (11). Hinterhüften hinten mit Börstchen. Hinterschienen aussen vorne und aussen hinten bewimpert. Haarkleid des Abdomens sehr kurzhaarig und fein. Ohne Diskalborsten *Microcarcelia* gen. n.
13 (4). Mittelschienen innen in der Mitte mit 1 Borste.
14 (20). Klauen des Männchens lang.
15 (19). Hinterhüften mit Börstchen.
16(17, 18). Abdomen ohne Diskalborsten. Haarkleid des Abdomens mehr haarig. Fünftes Tergit länger behaart als die vorderen Tergite, zuweilen beborstet, die Borsten aber niemals dicht stehend und auf der Dorsal- sowie auf der Ventralseite büschelartig angeordnet *Carcelia* R. D.

1 (2). Drittes Fühlerglied ungemein lang und breit . . *pilosella* Bar.
2 (1). Drittes Fühlerglied niemals so lang und breit.
3 (4). Ohne Ozellarborsten . . . . *frontalis* Bar.
4 (3). Mit Ozellarborsten.
5 (6). Haarkleid des Abdomens sehr kurzhaarig und dicht, auf dem 4. Tergit gegen den Apikalrand noch dichter werdend, wo die Behaarung Sturmiafleck-artig ist . . . . *sexta* Bar.
6 (5). Haarkleid des Abdomens von verschiedener Beschaffenheit, niemals jedoch mit Sturmiafleck-artiger Binde neben dem Apikalrand des 4. Tergites.
7(18). Beine schwarz, nur die Schienen fast immer mehr oder weniger rot.

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* Dieser Art sehr ähnlich ist die paläarktische **E. caspica** sp. n. ♂. Dunkle Fliege mit schwach bereiftem Körper, gebändertem Abdomen und schwarzen Schienen mit Ausnahme der vorderen, welche braun sind. Weicht in den Genitalien von *kockiana* ab: Paraloben gegen das Ende zu deutlich verjüngt und Penis bedeutend breiter. Körperlänge 8 mm. Gebiet des Kaspischen Meeres.

8 (9). Schienen schwarz . . . . *malayana* sp. n.
9 (8). Schienen rot.
10(11). Mittelschenkel vorne ohne Borsten, nur mit feiner Behaarung *buitenzorgiensis* Bar.
11(10). Mittelschenkel vorne immer mit 1 oder mehreren Borsten.
12(13). Stirnbreite beträgt drei Viertel der Augenbreite . . . *rasella* Bar.
13(12). Stirn schmäler.
14(15). Haarkleid des Abdomens aus auffallend dicken und kurzen Börstchen bestehend . . . . *setosella* Bar.
15(14). Haarkleid von anderer Beschaffenheit.
16(17). Körperbereifung mehr weisslich. Angularborste des Schildchens bedeutend dicker und länger als die Basalborste *modicella* (v. d. Wulp).
17(16). Körperbereifung mehr goldig. Angularborste ungefähr gleich dick und lang wie die Basalborste . . *sumatrana* Towns.
18(7). Beine rot, mit schwarzen Schenkeln oder Tarsen.
19(20). Schenkel und Schienen rot, Tarsen zum grössten Teil schwarz *albifacies* Towns.
20(19). Schienen und der grösste Teil der Tarsen rot, Schenkel schwarz *tjibodana* Towns.

17(16, 18). Abdomen mit Diskalborsten. Haarkleid des Abdomens mehr borstig und lang. Vordertarsen des Weibchens nicht verbreitert. . . . . *Parexorista* B. B.

1(2). Stirn im Profil um soviel vorragend als ihre Breite am Scheitel beträgt. Drittes Fühlerglied breit, der vordere Rand etwas gewölbt. Oralprofil mehr gewölbt, die Vibrissen daher vom Unterrand des Kopfes weiter entfernt. Haarkleid des Abdomens feiner, die Diskalmakrochäten deutlich ausgeprägt. Dritte Längsader an der Basis mit 3 Börstchen. Beugungsstelle der Medialader stumpfwinkelig . . . . . *latistylata* sp. n.
2(1). Stirn weniger vorragend. Drittes Fühlerglied schlank, dem Ende zu deutlich verbreitert. Drei reklinate Frontalborsten. Vibrissen dem Unterrande des Kopfes genähert. Haarkleid des Abdomens gröber, Diskalmakrochäten mehr undeutlich. Dritte Längsader mit 2 Börstchen an der Basis. Beugungsstelle der Medialader rechtwinkelig (*Senexorista*) *sumatrana* (Towns.).

18(16, 17). Vordertarsen des Weibchens verbreitert. Paläarktisch *Pelmatomyia* B. B.
Gatt.-Type: *Exorista phalaenaria* Rondani 1859.

19 (15). Hinterhüften hinten ohne Börstchen. Haarkleid des Abdomens fein. Keine Diskalborsten. Behaarung der Augen weniger lang und dicht als bei den anderen Gattungen des *Carcelia*-Komplexes. Ozellarborsten fehlend. Innere Vertikalborsten gekreuzt. Klauen des Männchens mässig lang *Zygocarcelia* Towns.

20 (14). Klauen des Männchens kurz.

21 (26). Ozellarborsten vorhanden. Fünftes Abdominaltergit mit nicht dicht stehenden Borsten oder nur mit längerer Behaarung.

22 (23). Stirnprofil etwas länger als das Gesichtsprofil. Drittes Fühlerglied nicht besonders lang. Haarkleid des Abdomens fein. Keine Diskalborsten . . . . *Carceliopsis* Towns.

23 (22). Stirnprofil kürzer als das Gesichtsprofil. Drittes Fühlerglied aussergewöhnlich lang.

24 (25). Vordertarsen des Weibchens nicht verbreitert. Haarkleid des Abdomens borstig, mit deutlichen Diskalborsten *Isocarceliopsis* gen. n.

25 (24). Vordertarsen des Weibchens deutlich verbreitert. Paläarktisch *Isocarcelia* Vill.
Gatt.-Type: *I. inconspicua* Villeneuve 1926.

26 (21). Ohne Ozellarborsten. Fünftes Abdominaltergit dorsal und ventral dicht und buschig beborstet. Haarkleid des Abdomens sehr dicht und kurz. Klauen des Männchens kurz oder nur mässig lang . . . . *Asiocarcelia* gen. n.

1(2). Klauen der Vordertarsen beim ♂ ebenso lang wie das letzte Tarsenglied. Schildchen rot. Drei reklinate Frontalborsten. Körperbereifung weisslichgrau . . . . *caudata* (Bar.).

2(1). Klauen der Vordertarsen beim ♂ viel kürzer als das letzte Tarsenglied. Schildchen schwarz, 2 reklinate Frontalborsten. Körperbereifung bläulichweiss . . . . . *caudatella* (Bar.).

BESCHREIBUNGEN DER GATTUNGEN UND ARTEN.

Catacarcelia Townsend (15), p. 64.

Gatt.-Type : *C. kockiana* Towns. (15), p. 64.

Thorax mit 3 oder 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens nicht dicht, borstig, ohne Diskalborsten. Mittelschienen innen in der Mitte ohne Borste. Hinterhüften hinten ohne Beborstung. Klauen des Männchens sehr lang. Hinterschienen aussen vorn mit einer aus nicht zahlreichen Borsten bestehenden Borstenreihe. Der letzte Abschnitt der Medialader fast so lang wie die Spitzenquerader.

1. *C. kockiana* Towns. (15), p. 64. ♀.

Körper gestreckt, 3. Fühlerglied dreimal so lang wie das zweite. Kopf silbrig. Orbiten, Ozellendreieck und Scheitel goldig. Stirnstrieme und Fühler schwarz. Taster gelblich. Thoraxrücken und Schildchen mit goldigem Reif, Thoraxseiten und Schulterbeule weisslich bereift; 4 schwarze Längsstriemen, wovon die inneren schmäler und nur im ersten Drittel des Postscutums ausgeprägt sind. Nach Townsend besitzt diese Art 3 oder 4 Dorsozentralborsten. Unter einer Tachinidensendung, welche ich von Dr. L. G. E. Kalshoven in Buitenzorg erhielt, fand ich zwei Exemplare dieser Art: ein Männchen und ein Weibchen; ersteres hatte 4 Dorsozentralborsten, letzteres 3, wie der Townsend'sche Typus.—Abdomen schwärzlich, mit breiten goldgelben Basalbinden, welche die basale Hälfte der Segmente einnehmen. An den Abdomenseiten und auf dem Ventrum ist die Bereifung weisslich. Bei den beiden gezüchteten Exemplaren von Dr. L. G. E. Kalshoven sind die Basalbinden breiter und auch auf dem Dorsum mehr weisslich.—Beine schwarz. Flügel durchsichtig, glashell. Schüppchen weisslich. Körperlänge 7 mm, Flügellänge 6 mm.

Originalfundort : SUMATRA : Fort de Kock (*E. Jacobson*), JAVA : Seneng, 20.iii. und 16.vi.1932 (*L. G. E. Kalshoven*).

2. **C. rondaniella** sp. n. ♂.

Körper gedrungener als bei *Catacarcelia kockiana* Towns. Stirn am Scheitel breiter als die halbe Augenbreite. Orbiten und Wangen silbrig. Stirnstrieme schmäler als die Orbite. Fühler lang; 3. Glied mehr als dreimal so lang wie das zweite. Taster hellrot. Wangen nur so breit wie ein Drittel der Breite des 3. Fühlergliedes. Stirn etwas vorspringend. Stirn- und Gesichtsprofil gleich lang. Thorax mit spärlicher weisser Bereifung. Längsstriemung mehr undeutlich. Schildchen schwarz. Abdomen schwarz, mit weisser Bereifung. Basalbinden des 3. und 4. Tergites weniger breit, nicht scharf begrenzt, die Basalbinde des 5. Tergites sehr schmal. Apikalbinden glänzend schwarz. 2. und 3. Tergit mit je einem Paar mittlerer Randborsten. Beine schwarz. Flügel durchsichtig. Schüppchen weiss. Körperlänge 6 mm.

Originalfundort : FORMOSA : Kankau und Takao (*H. Sauter*).

Eucarcelia gen. n.

Gatt.-Type : *Tachina excisa* Fall. (10), p. 32.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens haarig oder borstig, mit oder ohne Diskalborsten. Mittelschienen innen in der Mitte ohne Borste. Hinterhüften hinten nackt. Klauen des Männchens lang.

1. *E. excisa* (Fall.) (10), p. 32, ♂, ♀.

Mittelgrosse bis grosse Art mit dichtem, gelbbraunem Toment und nicht dichtem, borstigem Haarkleid, jedoch ohne echte Diskalmakrochäten; nur zuweilen auf dem 4. Hinterleibsringe mit 1–2 stärkeren Borstenhaaren.—Stirn am Scheitel etwas breiter als die halbe Augenbreite. 4–5 herabsteigende Frontalborsten. Orbiten, Wangen und Backen gelblich. Wangen und Backen ungefähr gleichbreit und etwas schmäler als das 3. Fühlerglied. Abdomen etwas länglicher geformt wie bei *separata* Rond. Drittes Segment mit 2 Randborsten. Alle Schienen an den Enden deutlich dünkler gefärbt. Vorderschienen hinten mit 1 Borste. Hinterschienen mit regelmässiger Borstenreihe und Zwischenborste. Flügelwurzel gebräunt. Hypopygium mit ziemlich kurzem Forceps und Paraloben. Penis mit zwei Klappen und Basalzahn.

Originalfundort : EUROPA. Aus der orientalischen Region mir bekannt von FORMOSA : JAVA, aus BRITISCH-INDIEN und SIAM, sowie von CEYLON (British Museum, *Col. Yerbury*).

2. **E. grossa** sp. n.

Grosse, breit-ovale, haarige Art, aus der Verwandtschaft von *rutilla* B.B., mit dichtem, gelblichem Toment und dunkelbraunen Schienen.—Stirn am Scheitel halb so breit wie ein Auge. Stirnstrieme an der schmälsten Stelle um ein Drittel schmäler als die Orbite. Orbiten und Wangen im oberen Teil (bis zum Ende des 2. Fühlergliedes) goldig. Wangen unten nur halb so breit wie das 3. Fühlerglied. Backen ebenso hoch als die Wangen breit sind. 3. Fühlerglied fast dreimal so lang wie das zweite. Fühlerborste fein und sehr lang. 4 herabsteigende Frontalborsten. Taster hell, rötlich. Thorax gelblich bestäubt. Schildchen rötlich durchscheinend. Abdomen etwas goldiger bestäubt als der Thorax. 3. 4. und 5. Tergit mit schmalen, glänzend schwarzen Hinterrandbinden, 3. Tergit mit deutlicher schwarzer Längsmittellinie, das 4. mit der Spur einer solchen. 3. Tergit mit 2 Randborsten, 4. mit mehreren (mehr als 1 Paar). Hinterschienen aussen vorne mit einer Reihe dichtstehender, kurzer Borsten und Zwischenborste. Flügel an der Wurzel und am Vorderrand deutlich gebräunt, mit braunen Adern, die ausserdem noch braun gesäumt sind. Körperlänge 11 mm.

Nur 1 schlechterhaltenes Männchen aus Formosa.

3. **E. dammermani** sp. n. ♂, ♀.

♂. Stirn am Scheitel halb so breit wie ein Auge. 2 reklinate, 4 gekreuzte und 3 herabsteigende Frontalborsten. Ozellarborsten lang, nach vorne gebogen. Stirnstrieme schmäler als eine Orbite. Stirn im Profil um die Hälfte des Augenquerdurchmessers vorspringend. Backen ebenso breit wie das 3. Fühlerglied, Wangen etwas schmäler. 3. Fühlerglied viermal so lang wie das zweite. Fühlerborste fein, sehr lang und sehr hoch inseriert. Taster hellrot, mit feinem, weissem Reif. Kopf goldig. Hinterkopf gelblichweiss behaart. Körper dicht, bräunlichgelb bestäubt. Schildchen rötlich durchscheinend. Abdomen einfarbig. 2. Hinterleibsring mit 1 Paar langer Borsten, 3. mit 2 Paar. Ohne Diskalborsten. Haarkleid nicht dicht, ziemlich langhaarig. Flügel deutlich gebräunt, mit gelblicher Basis. 3. Längsader mit 3 Börstchen an der Basis. Schüppchen gelblich. Beine schwarz, mit rötlicher Schienenmitte. Vorderschienen hinten mit 1 Borste. Hinterschienen regelmässig beborstet, mit Zwischenborste. Körperlänge 9 mm.

♀. Stirn am Scheitel um ein Drittel schmäler als ein Auge. 2 gekreuzte Frontalborsten. 3. Fühlerglied dreimal so lang wie das zweite. Haarkleid des Abdomens weniger langhaarig. Körperlänge 9 mm.

Java : Idjen, 1850 m., Ongop-Ongop (*Dammerman*).

4. **E. indica** sp. n. ♂.

Stirn am Scheitel halb so breit wie ein Auge. Stirnstrieme viel schmäler als eine Orbite. Orbiten, und Wangen weisslich schimmernd. Wangen schmäler als das 3. Fühlerglied. Backen ebenso hoch als die Wangen breit sind. 3. Fühlerglied ungefähr viermal so lang wie das 2., an der Basis etwas rötlich. Taster hell, rötlich. Seiten des Thoraxrücken und Apikalhälfte des Schildchens rötlich. Bereifung des Thorax etwas goldig. Abdomen dorsal mehr goldig, ventral mehr silbrig bereift. Flügel mit gebräunter Wurzel und braunen Adern. Schienen dunkelbraun, fast schwarz. Charakteristisch für diese Art ist der Bau des Hypopygiums, besonders der Paraloben, welche breit und ventralwärts hakenförmig gebogen sind. Körperlänge 10 mm.

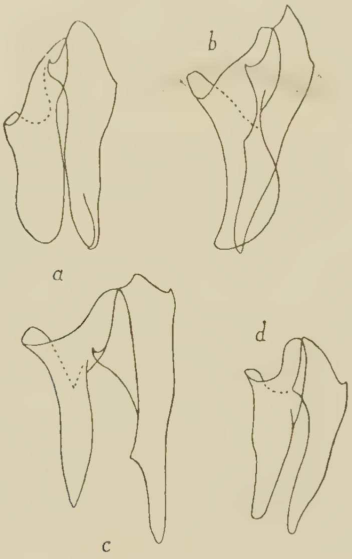

Abb. 1.—Forceps (rechts) und Paralobe (links) von : (a) *Zygocarcelia cruciata* Towns., (b) *Eucarcelia indica* sp. n., (c) *Catacarcelia rondaniella* sp. n., (d) *Carcelia modicella* (v. d. Wp.).

Nur ein stark beschädigtes Männchen aus Britisch-Indien ohne genauere Daten.

5. *E. rufa* (Bar.) (1), p. 33, ♂, ♀.

Prächtige, mittelgrosse, länglich gebaute Fliege mit hellbraunen Beinen, bräunlichem Körper, lichter, etwas goldiger Bereifung, rotem 2. Fühlerglied und etwas gebräunten

Flügeln.—Stirn am Scheitel um ein Drittel schmäler als die Augenbreite. Die dunkelbraune Stirnstrieme etwas schmäler als eine Orbite. Orbiten, Wangen und Backen von rötlichgelbem Schimmer. 3. Fühlerglied schmal, viermal so lang wie das zweite. Nur 2 herabsteigende Frontalborsten. Wangen und Backen nicht besonders schmal. Haarkleid des Abdomens aus nicht dichstehenden, kurzen Börstchen bestehend. Hinterrandbinde des 4. Segmentes und Spitze des Abdomens glänzend schwarz. 2.–4. Segment dicht bestäubt, mit dunkler Längsmittellinie, welche durch den Toment durchschimmert. Beine schlank. Vorderschienen hinten mit 1 Borste. Hinterschienen aussen vorne mit regelmässiger Borstenreihe, deren Borsten nicht dicht stehen, mit Zwischenborste; aussen hinten mit regelmässiger Börstchenreihe, dazwischen keine längere Borste. Klauen des Männchens lang. Hypopygium mit sehr charakteristischem Forceps, welcher auf der dorsalen Seite, vor dem apikalen Viertel, tief eingebuchtet ist. Dieser apikale Teil ist mit in Bechern stehenden Tastbörstchen dicht bedeckt, was der Oberfläche ein hügeliges Aussehen verleiht.

FORMOSA: Kankau, v.–vi.1912 und Macuyama, v.–vi.1914 (*H. Sauter*). Durch den Vergleich der Typen würde es sich vielleicht herausstellen, dass *E. rufa* mit *Parexorista rubeola* v.d. Wulp (30), p. 168, identisch ist.

6. *E. sumatrana* (Towns.) (15), p. 66, ♂. (*Sisyropa* Towns. *nec* B.B.).

Kopf blassgoldig, die Orbiten etwas intensiver gefärbt. Clypeus, Facialien und Hinterkopf mehr silbrig-grau. Thoraxseiten, sowie die drei ersten Abdominalsegmente auf dem Ventrum silbrig bereift. Die ganze Dorsalseite des Körpers mit goldigem Reif. Schildchenbasis und die 5 Thorakalstriemen schwärzlich. Grundfarbe des Abdomens rötlichgelb, Ventrum mit schmaler schwarzer Längsstrieme in der Mitte. 5. Tergit schwarz, mit

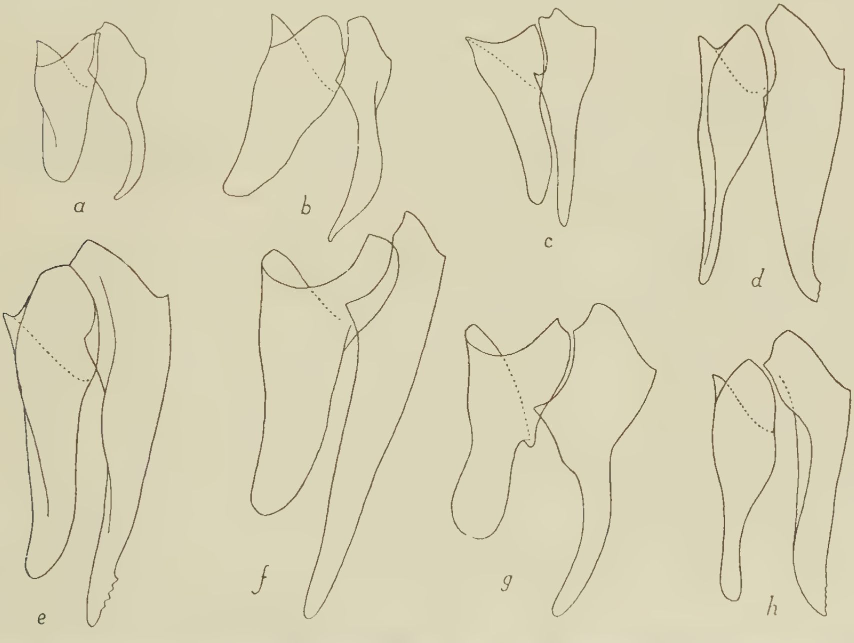

ABB. 2.—Forceps (rechts) und Paralobe (links) von: (a) *Isocarceliopsis hemimacquartioides* sp. n., (b) *Parexorista latistylata* sp. n., (c) *Eucarcelia caspica* sp. n., (d) *Asiocarcelia caudatella* (Bar.), (e) *Eucarcelia sumatrana* (Towns.), (f) *Eucarcelia grossa* sp. n., (g) *Eucarcelia dammermani* sp. n., (h) *Asiocarcelia pseudocaudata* sp. n.

breiter goldgelber Basalbinde, welche zwei Drittel des Tergites einnimmt; 4. Tergit mit glänzend schwarzer Apikalbinde, welche auf dem Dorsum breit, auf dem Ventrum schmäler ist; 3. Tergit mit schwarzem, manchmal dreieckigem Fleck in der Mitte; 2. Tergit in geringerer oder grösserer Ausdehnung schwarz oder ganz schwarz. Flügel an der Basis und Costa gelblich. Schüppchen gelblich. Körperlänge 8 mm., Flügellänge 7½ mm.

Originalfundort: SUMATRA: Suban Ajam, vii.1916.—Im British Museum befindet sich ein Exemplar aus CEYLON (*Col. Yerbury*).—FORMOSA: Toa-Tsui-Kutsu und Hoozan (*H. Sauter*).

Townsend hat diese Art in die Gattung *Sisyropa* B.B. eingereiht. Die Gattungstype, *Tachina thermophila* Wied., ist jedoch aus einem ganz anderen Verwandtschaftskreis und unterscheidet sich von allen anderen Gattungen des *Carcelia*-Komplexes durch das Vorhandensein von 3 Sternopleuralborsten, 2 Lateralborsten auf dem Schildchen, sowie durch höhere Backen.

7. *E. kockiana* (Towns.) (15), p. 65, ♂, ♀
= *Carcelia prima* forma a. Bar. (1), p. 31.

Mittelgrosse Fliege mit glänzend schwarzen Hinterrandbinden auf dem breiten Hinterleib. Bereifung etwas gelblich, ebenso die Orbiten.—Stirn am Scheitel etwas schmäler als die halbe Augenbreite, bei kleineren Exemplaren zuweilen breiter. Stirnstrieme mässig schmal, gerade so breit oder schmäler wie eine Orbite. Mit 2 Reklinaten. Wangen halb so breit wie das 3. Fühlerglied. Backen etwas breiter als die Wangen. Abdomen dicht behaart. Beine schwarz. Hinterschienen regelmässig bewimpert. Klauen des Männchens lang. Flügel deutlich gebräunt. Hypopygium *excisa*-ähnlich, jedoch ist der Forceps schmäler und weniger sklerosiert.

Originalfundort: SUMATRA: Fort de Kock.—Zahlreiche Exemplare von verschiedenen Orten auf FORMOSA: Sokutsu, ix.1912; Kankau, iv.–ix.1912; Taihorinsho, ix.1909 (*H. Sauter*). Auch sonst in der ganzen orientalischen Region weit verbreitet.—Ausserdem aus Tsingtau (*Prof. Hoffman*) und Shantung, Tsinan (*E. Hindle*).

Diese gewöhnlichste und in der orientalischen Region am weitesten verbreitete Art könnte man für *evolans* Wied. *in sensu* Bezzi halten (conf. Bezzi (4), p. 209); ob diese jedoch die echte Wiedemann'sche *evolans* ist, kann ich aus der Literatur allein nicht entnehmen, nachdem diese Art von den verschiedenen Autoren verschieden aufgefasst wird: Villeneuve (24, 25) hat die Typen von *evolans* gesehen und stellt sie nahe zu *gnava* Mg. und *bombylans* R.D., also zu Arten einer anderen Gattung (*Carcelia* s. str.); Curran (9), welcher ebenfalls den Typus studierte, schreibt, dass das 3. Fühlerglied bei *evolans* doppelt so lang wie das 2. ist; Brauer und Bergenstamm (8), p. 323, führen beim Weibchen die Länge des 3. Fühlergliedes als die dreifache des 2. an; Bezzi (4) beschrieb *Carcelia leptocephala* von den Fidschi-Inseln als eine mit *evolans* aufs engste verwandte Art und Miss D. Aubertin am British Museum, welche auf mein Ansuchen hin den Typus von *C. leptocephala* untersuchte, hatte die Freundlichkeit, mir mitzuteilen, dass sie mit meiner *Carcelia* (s. str.) *malayana* sehr ähnlich, jedoch nicht identisch ist. Es herrscht also über die Art *evolans* ziemliche Unklarheit, und da ich den Typus nicht gesehen habe, muss ich die Frage einer eventuellen Synonymie vorläufig offen lassen. Den Typus von *kockiana* hingegen kenne ich gut und es steht für mich fest, dass sie keine *Carcelia* s. str. ist.

E. kockiana scheint auch unter den gezüchteten Raupenfliegen sehr gemein zu sein, da ich ihr in dem Material, welches ich zur Bestimmung erhalte, auf Schritt und Tritt begegne.

In den Sendungen aus dem Imperial Institute of Entomology in London fand ich Exemplare mit folgenden Daten :—

Ex *Eupterote* sp., INDIA : Dehra Dun, U.P. (*S. N. Chatterjee*), 8.–10.vii.1930.

Ex *Hyblaea puera* Wlk., INDIA : New Forest, Dehra Dun, U.P. (*S. N. Chatterjee*), 5.x.1931.

Ex SPHINGIDAE, NEW GUINEA (*J. L. Froggatt*), 3.iii.1933.

Ex *Tirathaba rufivena*, NEW GUINEA (*J. L. Froggatt*), xi.1931.

Ex *Diacrisia obliqua* L., INDIA : Punjab (*S. A. Shah*), 24.ii.1933.

Ex *Chloridea* on Saf flower, S.-INDIA : Coimbatore, 1.xi.1932.

In den Sendungen aus dem Instituut voor Plantenziekten in Buitenzorg fand ich Exemplare mit folgenden Daten :—

Ex *Macroglossum* sp., JAVA : Buitenzorg, 1928.

Ex *Bombotelia jacosatrix*, JAVA : Buitenzorg (*Dr. C. Franssen*), 1933.

Ex *Hyblaea puera* Wlk., JAVA : Semarang (*Dr. L. G. E. Kalshoven*), vi., vii.

Ex *Euproctis minor*, JAVA : Buitenzorg (*Dr. C. Franssen*), 1930. Aus dem British Museum wurden mir für diese Art folgende Lokalitäten bekannt : INDIA : Pusa, 14.ii.1920 (*R. Senior-White*).—CEYLON (*Col. Yerbury*).—CEYLON : Suduganga, 9.iii.1919. 17.vi.1928 (*R. Senior-White*).—CEYLON : Pundaluoya, vii.1932 (*E. E. Green*).—CHINA : Hong-Kong (*J. J. Walker*).

8. *E. prima* (Bar.) (1), p. 31
= *Carcelia prima* forma b. Bar. (1), p. 31.

Unterscheidet sich von *kockiana* nur dadurch, dass sie bloss 1 reklinate Frontalborste besitzt.

FORMOSA : Kankau, vi.–ix.1912 (*H. Sauter*).

Nachdem ich unter den zahlreichen Exemplaren von *kockiana*, welche ich zu untersuchen Gelegenheit hatte, kein weiteres Exemplar mit nur 1 Reklinaten gefunden habe, halte ich obige formosanischen Exemplare * für eine besondere Art.

9. *E. secunda* (Bar.) (1), p. 31.

Grosse, etwas goldig bereifte Art mit dunkelbraunen Schienen und mit weniger scharf ausgeprägten Hinterrandbinden auf den Abdominalsegmenten. Wangen und Backen von gleicher Breite wie das 3. Fühlerglied. Mit 2 Reklinaten. Forceps im apikalen Teil ventralwärts gebogen; vordere Haken sehr breit, blattförmig. Sonst wie vorhergehende Art.

FORMOSA : Sokutsu, ix.1912 (*H. Sauter*).

10. *E. quarta* (Bar.) (1), p. 33.

Grosse, etwas bräunlich bereifte Art mit glänzend schwarzen Hinterrandbinden auf den Hinterleibsringen.—Stirn schmäler als die halbe Augenbreite. Orbiten gelblich. Die Abdomenseiten etwas rötlich. Schienen dunkelbraun. Flügelgeäder mit feinem aber deutlichem braunen Saum. Forceps ähnlich wie bei *kockiana* aber stärker entwickelt. Paraloben aussen und innen lang behaart. Sonst wie *kockiana*, nur das Abdomen etwas spärlicher behaart.

FORMOSA : Gebiet des Shija-Stammes, v.–vi.1912 (*H. Sauter*).

11. *E. quinta* (Bar.) (1), p. 33.

Kleine, grau bereifte Fliege mit dunkelbraunen Schienen, schmalen Wangen und Backen und glänzend schwarzen Hinterrandbinden des Abdomens, dessen Haarkleid aus mehr langen und spärlichen Börstchen besteht. Hinterschienen aussen vorn mit einer Reihe von kurzen, dicht stehenden Borsten und mit Zwischenborste. Hypopygium dem von *kockiana* ähnlich, nur ist der Forceps ebenso stark sklerosiert wie die Paraloben. Klauen des Männchens sehr lang. Flügel glashell.

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* Befinden sich im Deutschen Entomologischen Institut in Berlin-Dahlem.

quinta a—Stirnstrieme schmäler als eine Orbite.
quinta b—Stirnstrieme ebenso breit wie eine Orbite.
FORMOSA: Kankau, vi. und xi.1912 (*H. Sauter*).

Myxocarcelia gen. n.

Gatt.-Type: *Carcelia hirsuta* Bar. (1), p. 38.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens fein, ohne Diskalborsten. Mittelschienen innen in der Mitte ohne Borste. Hinterhüften hinten beborstet. Klauen des Männchens lang. Ozellarborsten vorhanden. Drittes Fühlerglied bedeutend länger als die dreifache Länge des zweiten.

1. *M. hirsuta* (Bar.) (1), p. 38.

Kleine, borstige Fliege mit sehr langen Fühlern, dunkelbraunen Schenkeln und Schienen, schwarzem Abdomen, welches weisslichgrau bereift ist und ziemlich breite Hinterrandbinden hat.—Stirn am Scheitel halb so breit wie ein Auge. Mit Ozellarborsten. Stirnstrieme halb so breit wie die Orbite. Frontalborsten, Fühler, Wangen und Backen wie bei *Carcelia pilosella*. Mittelschienen innen ohne Borste. Hinterhüften hinten mit Borsten. Hinterschienen aussen vorn mit Borstenreihe, aussen hinten mit langer Borste. Flügel etwas bräunlich. Hypopygium mit schmalen, ventralwärts gebogenen Paraloben, welche länger als der Forceps sind. Dorsalspange des Penis ist weniger verlängert als bei *pilosella*.

FORMOSA: Kankau, 7.vii. und 7.viii.1912 (*H. Sauter*).

2. *M. aberrans* (Bar.) (1), p. 27.

Mehr kleine, länglich gebaute Art mit dunklen Beinen und rötlichem, kurz beborstetem Abdomen, dessen Längsstrieme und Spitze schwarz ist. Diskalborsten fehlen. — Stirn ist halb so breit wie ein Auge. Stirnstrieme so breit wie eine Orbite. Wangen und Backen sehr schmal. Nur 2 herabsteigende Frontalborsten. Fühler lang, 2. Fühlerglied kurz, rot; 3. Fühlerglied fünfmal so lang wie das zweite. 2. Abdominal-segment ohne Randborsten. Beine dunkelbraun, fast schwarz, mit mehr feinen Borsten. Vorderschienen hinten mit 1 Borste. Mittelschienen innen ohne, aussen vorn mit 1 Borste. Hinterschienen aussen vorn mit regelmässiger Borstenreihe und Zwischenborste, aussen hinten nur mit 2 schwach entwickelten Borsten. Hinterhüften hinten mit Borste. Klauen des Männchens lang. Hypopygium mit langem Forceps, länglichen Paraloben, welche ziemlich breit sind. Penis ohne Basalzahn.

FORMOSA: Kankau, 7.viii.1912 (*H. Sauter*).

Carceliella gen. n.

Gatt.-Type: *Carcelia octava* Bar. (1), p. 35.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens fein, ohne Diskalborsten. Mittelschienen innen in der Mitte ohne Borste. Hinterhüften hinten beborstet. Klauen des Männchens lang. Ozellarborsten fehlend. Drittes Fühlerglied ungefähr dreimal so lang wie das zweite.

1. *C. octava* (Bar.) (1), p. 35.

Kleine, schwarze, borstige Fliege mit nur wenig Toment und mit Sturmiafleck. — Stirn abgerundet. Ozellarborsten fehlen. Wangen und Backen sehr schmal. Schildchen schwarz. Vorderschienen hinten mit 2 Borsten. Mittelschienen innen ohne Borste. Hinterhüften beborstet. Hinterschienen vorn regelmässig beborstet, aussen hinten mit Borstenreihe, jedoch ohne stärkere Borste dazwischen. Hypopygium wie bei *Carcelia sexta.*

octava a—Stirn vollständig gerundet; Körper klein (5 mm.); Abdomen länglich oval.—FORMOSA: Kankau, viii.-ix.1912, iv.1912 und iii.1913 (*H. Sauter*).

octava b—Stirn etwas vorspringend; Körper grösser (7 mm.); Abdomen breit oval.—FORMOSA, Kankau, viii.1912 (*H. Sauter*). Nur 1 Exemplar.

Bemerkung: Es ist möglich, dass hier zwei selbständige Arten vorliegen.

Eocarcelia Towns. (16), p. 582
= *Eocarceliopsis* Towns. (17), p. 392.

Gatt.-Type: *E. ceylanica* Towns. (16), p. 582.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens mehr oder weniger fein, ohne Diskalborsten. Mittelschienen innen in der Mitte ohne Borste. Hinterhüften hinten nicht beborstet. Klauen des Männchens kurz.

1. *E. ceylanica* Towns. (16), p. 583
= *Eocarceliopsis bakeri* Towns. (17), p. 393
= *Carcelia tertia* Bar. (1), p. 32.

Grosse Art mit grauer Bereifung, mit glänzend schwarzen Hinterrandbinden des Abdomens und mit breiterer Stirn, deren Breite zwei Drittel der Augenbreite beträgt. Mit 2 Reklinaten. Orbiten, Wangen und Backen silbrigweiss. Schienen dunkelbraun. Klauen des Männchens kurz. Flügel fast nicht gebräunt. Haarkleid des Abdomens nicht so dicht wie bei *Eucarcelia kockiana* und *Eucarcelia secunda.* Forceps gegen das Ende zu ganz regelmässig verjüngt. Paraloben mit kurzen Borstenhaaren. Sonst wie *E. kockiana.*

Originalfundort: CEYLON.—FORMOSA: Taihorinsho ix.1900 (*H. Sauter*).—PHILIPPINEN: Dapitan, Mindanao.

2. *E. aurata* (Towns.) (15), p. 65, ♂, ♀
= *Carcelia singgalangia* Towns. (15), p. 65
= *Carcelia distincta* Bar. (1), p. 32.

Durch das gebänderte Abdomen, die kurzen Klauen des Männchens, das Hypopygium vom *excisa*-Typus (Penis mit Basalzahn) ist sie *E. ceylanica* ähnlich, unterscheidet sich von dieser aber deutlich durch das haarige Haarkleid und den mehr goldigen Reif des Abdomens und auch durch einige Besonderheiten im Hypopygiumbau. — Stirn am Scheitel breiter als die Hälfte der Augenbreite. Stirnstrieme deutlich schmäler als eine Orbite. Wangen und Backen nicht besonders schmal. 3. Fühlerglied fast dreimal so lang wie das zweite. Fühlerborste in den beiden basalen Fünfteln verdickt. Herabsteigende Frontalborsten nicht zahlreich, aber ziemlich dick und kurz. Ozellarborsten deutlich. 2 Reklinate. Taster rötlich, keulenförmig, am Ende mit kurzen, gedrängt stehenden Borsten besetzt, so dass die Tasterspitze etwas schwärzlich aussieht. Thorax gelblichgrau bestäubt, mit 4 gewöhnlichen Längsstriemen. Schildchen in apikaler Hälfte durchscheinend, rot. Borsten auf Thorax und Schildchen beträchtlich kürzer als bei den anderen Arten des *Carcelia*-Komplexes. Abdomen mit goldigem Toment, an den Seiten etwas rötlich durchscheinend, mit ziemlich schmalen, glänzend schwarzen Hinterrandbinden. 2. und 3.

Segment mit je 1 Paar Marginalborsten, welche dick und kurz sind. Auch das fünfte Segment nur kurz beborstet. Beine schwarz, mit ganz kurzen Klauen. Hinterschienen aussen vorn dicht und regelmässig bewimpert, mit Zwischenborste; aussen hinten mit einer Reihe von kurzen Börstchen und einer stärkeren Borste, welche jedoch nicht so stark wie bei *E. ceylanica* entwickelt ist. Flügel glashell. Forceps im apikalen Teil deutlich ventralwärts gebogen. Paraloben mit langen Haaren und mit kürzeren, dicken Borsten. Vordere und hintere Haken viel breiter als bei *ceylanica*. Körperlänge 10 mm.

Originalfundort: SUMATRA: Fort de Kock.—SUMATRA: Gunung, Singgalang.—FORMOSA: Sokutsu, ix.1912 (*H. Sauter*).

Microcarcelia gen. n.

Gatt.-Type: *Carcelia septima* Bar. (1), p. 35.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens sehr kurz und fein, ohne Diskalborsten. Mittelschienen innen ohne Borste in der Mitte. Hinterschienen aussen vorn und aussen hinten bewimpert. Klauen des Männchens kurz.

1. *M. septima* (Bar.) (1), p. 35. ♂.

Mittelgrosse, dicht und gelblich bestäubte Fliege mit abgerundeter Stirn, ohne Ozellarborsten, mit schwarzem Schildchen und kurzem, breitem Abdomen; dieses mit schwarzen Hinterrandbinden und Längsmittellinie. — Stirnbreite beträgt am Scheitel zwei Fünftel der Augenbreite, Wangen und Backen sehr schmal. Abdomen an den Seiten schwach rötlich. Sturmiafleck gross, nicht scharf begrenzt, auf der Bauchseite des 4. Hinterleibsringes sich befindend. Schienen dunkelbraun. Vorderschienen hinten mit 2 Borsten. Mittelschienen innen ohne Borste. Hinterschienen aussen vorn bewimpert, ohne deutliche Zwischenborste; aussen hinten mit Wimperreihe, bestehend aus kurzen Börstchen und mit stärkerer Borste dazwischen. Hypopygium wie bei *Carcelia sexta*.

FORMOSA: Kankau, viii.1912 (*H. Sauter*).

Carcelia R.D. (13), p. 176.

Gatt.-Type: *C. bombylans* R.D. (13), p. 177 (*in sensu* Villeneuve).

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens dicht und fein, ohne Diskalborsten. Fünftes Tergit länger behaart als die vorderen, zuweilen beborstet, jedoch stehen die Borsten niemals sehr dicht und sind auch weder dorsal noch ventral buschig angeordnet. Mittelschienen innen in der Mitte mit Borste. Hinterhüften hinten beborstet. Klauen des Männchens sehr lang.

1. *C. pilosella* Bar (1), p. 37.

Ziemlich kleine Art mit sehr langen Fühlern, dunkelbraunen Schienen, rötlichen Seiten des dicht und kurz beborsteten Abdomens, langen Klauen des Männchens und verlängerter Dorsalspange des Penis. — Stirn am Scheitel halb so breit wie ein Auge. Ozellarborsten vorhanden. Nur 2 herabsteigende Frontalborsten. 2. Fühlerglied kurz, 3. Fühlerglied lang und breit, mit hoch inserierter Fühlerborste. Wangen und Backen schmal, von gleicher Breite, mit abgerundeter Vibrissenecke. Hinterleib mit breiten Hinterrandbinden und deutlich ausgeprägter Längsmittellinie. Mittelschienen innen mit Borste. Hinterhüften hinten beborstet. Hinterschienen aussen vorn bewimpert, aussen hinten mit langen Borsten. Vordertarsen des Weibchens nicht verbreitert. Flügel etwas bräunlich. Forceps mit deutlichem Zahn zwischen den Zinken. Paraloben lang, deutlich sich verjüngend und nach vorn gebogen. Penis mit drei Klappen, welche keine deutlichen Zähnchen tragen. Vordere Haken länger und breiter als die hinteren.

FORMOSA: Kankau, vi., vii., ix.1912 (*H. Sauter*).

2. *C. sexta* Bar. (1), p. 34.

Grössere, schöne Carcelie mit grauem, etwas gelblichem, seidenartigem Toment und deutlichen aber schmalen schwarzen Hinterrandbinden auf dem Abdomen.—Stirn etwas vorspringend und am Scheitel schmäler als die halbe Augenbreite. Stirnstrieme schmäler als eine Orbite. Ozellarborsten vorhanden. Backen sehr schmal, um die Hälfte schmäler als die schmalen Wangen. Schildchen rötlich. Haarkleid des Abdomens kurzborstig, sehr dicht. Abdomenseiten rötlichbraun, Hinterrand des 4. Hinterleibsringes mit Sturmiafleck-artiger Behaarung. Hinterhüften mit Borsten. Schienen rötlichbraun. Vorderschienen hinten mit 2 Borsten. Mittelschienen mit Innenborste. Hinterschienen aussen vorn dicht bewimpert, mit Zwischenborste, aussen hinten mit starker Borste und einigen schwächeren Borsten. Klauen des Männchens lang. Hypopygium klein, zart; Penis mit verlängerter Glans; Ventralklappen verlängert, mit zwei undeutlichen Vorsprüngen; Dorsalspange lang, von den Klappen durch einen durchsichtigen, membranösen Teil getrennt, und am Ende mit membranöser Verlängerung. Forceps im Profil gesehen mit grossem Basalteil und kürzerem, streifenförmigem, am Ende abgerundetem Endteil; Paraloben ungefähr so lang wie der Forceps, jedoch breiter, mit geradem vorderen (ventralen) und am Ende etwas geschweiftem hinteren Rande.

FORMOSA: Taihorinsho, ix.1909 (*H. Sauter*).

3. *C. frontalis* Bar. (1), p. 43.

Kleine, dunkle Fliege mit abgerundeter Stirn und ohne Ozellarborsten. Für diese Art ist die Form des Forceps charakteristisch, welcher an der Spitze scharf dorsalwärts gekrümmt ist. — Stirn am Scheitel breiter als die Hälfte der Augenbreite. Stirnstrieme in der Mitte mehr als um die Hälfte schmäler als die Orbite. Haarkleid nicht dicht, aus kurzen Borsten bestehend. Schienen dunkelbraun. Hinterschienen bewimpert, mit langer Zwischenborste. Klauen des Männchens lang.

FORMOSA: Toa-Tsui-Kutsu, v.1914 (*H. Sauter*). Nur ein schlecht erhaltenes Männchen.

4. *C. albifacies* Towns. (15), p. 64, ♀.

Unterscheidet sich von *Carcelia sumatrana* Towns. durch Folgendes: Wangen unten breiter. Von den Abdominalsegmenten sind das 2. und 3. in ihrem mittleren Drittel, das 4. fast gänzlich und der mittlere Teil des 5. dunkelbraun. Die Seiten des 2. und 3. Segmentes rötlich. Mittlere Segmente mit schmalen goldigen Basalbinden, welche sich an den Seiten erweitern. 5. Segment an den Seiten breit goldig bereift. Beine gelblich, Tarsen dunkel, mit Ausnahme der Innenseite der beiden ersten Hintertarsenglieder. Flügel etwas getrübt, besonders längs der Adern. Schüppchen gelblichgrau. Körperlänge 10·5 mm., Flügellänge 8 mm.

SUMATRA: Gunung, Singgalang, 1800 m., 1925.

5. *C. tjibodana* Towns. (15), p. 65, ♂.

Unterscheidet sich von *Carcelia sumatrana* Towns. durch Folgendes: Stirnbreite beträgt am Scheitel ein Fünftel der Kopfbreite. Hinterschienen dicht bewimpert, ohne längere Borste in der Mitte. Abdomen rötlich, mittlere Segmente in der Mitte breit schwarz.

Tarsen im Basalteil mehr oder weniger gelblich. Flügel fast durchsichtig klar. Schüppchen gelblich. 3. Längsader mit 1 Borste an der Basis. Kleine Querader näher zur Mündung der Subcosta als zur 1. Radialader. Körperlänge 12 mm., Flügellänge 10 mm.

JAVA: Tjibodas, ii.1926.

6. *C. buitenzorgiensis* Bar. (1), p. 45.

Grosse Carcelie, welche *rasa* Macq. sehr ähnlich ist, sich aber von dieser durch das mehr borstige Haarkleid, die mehr bräunlichen Flügel und durch die viel feinere, im basalen Teil kaum verdickte Fühlerborste deutlich unterscheidet. Auch das Hypopygium ist bei beiden Arten ähnlich, jedoch nicht identisch. Bei *buitenzorgiensis* sind die hinteren Haken breiter und im mittleren Teil mit zahlreichen, dichtstehenden Tastbörstchen bedeckt.

Originalfundort: JAVA: Buitenzorg, 1919 (*Dr. W. Roepke*).—Aus dem British Museum kenne ich Exemplare aus folgenden Lokalitäten: CEYLON (*Col. Yerbury*).—INDIA: Darjiling Dist. Mungpoo, 14.vi.1920 (*R. Senior-White*). —INDIA: Assam (*W. F. Badgley*) und ASSAM: Shillong, 6.x.1920 (*R. Senior-White*).

Von gezüchteten Exemplaren sind mir folgende Daten bekannt:—

Ex *Dasychira* sp., CEYLON: KAHAWATTE, 17.x.1929 (*Dr. J. C. Hutson*).

Ex LYMANTRIIDAE, SIAM: Bangkok-Noi; Malaya, Kuala-Lumpur und Layang Layang Yohore, 12.i.1930 (*N. C. E. Miller*).

Ex *Parnara bada* Moore, JAVA: Buitenzorg, 28.ii.1928 (Tjiomas *Dr. v.d. Goot*).

7. *C. setosella* Bar. (1), p. 44.

Ziemlich grosse Art mit rötlichen Hinterleibsseiten und goldigem Toment auf Thorax und Abdomen, mit schmalen Wangen und Backen, mit nur 2 herabsteigenden Frontalborsten und langem, breitem 3. Fühlerglied, welches dreimal so lang ist wie das zweite. —Stirn am Scheitel halb so breit wie ein Auge. Stirnstrieme ebenso breit wie eine Orbite. Fühlerborste hoch inserierend. Haarkleid besteht aus nicht dicht stehenden, kurzen aber dicken Börstchen. Schienen hell. Flügel deutlich gebräunt. Steht am nächsten zu *rasella* Bar., auch nach dem Bau des Hypopygiums; unterscheidet sich aber durch die schmäleren Wangen und Backen und durch das borstige Haarkleid.

FORMOSA: Sukutsu, v.1912 (*H. Sauter*).

8. *C. modicella* (v.d. Wulp) (29), p. 178.

Sehr ähnlich *buitenzorgiensis* Bar., sich jedoch von dieser durch die geringere Körperlänge und das bedeutend längere Haarkleid des Abdomens deutlich unterscheidend. Ausserdem ist das Stirnprofil etwas länger und das 5. Abdominaltergit nicht so dicht beborstet. Die Originalbeschreibung v.d. Wulps bezieht sich meines Erachtens auf ein Gemisch von zwei oder mehreren Arten und daher gibt er die Körperlänge bis zu 9 mm. an. Alle mir bekannten Exemplare dieser Art waren nicht länger als 7 mm.

Originalfundort: JAVA.

Die Originalexemplare dieser Art sind aus *Macroglossum*, *Ophideres* und *Dasychira* gezüchtet. Bezzi (3) führt noch *Caprina conchylialis* und *Stauropus alternus* als Wirte an. Mir dagegen sind aus *Macroglossum* bekannt: *Eucarcelia kockiana* (Towns.); aus *Ophideres: Winthemia albiceps* Malloch; aus *Dasychira grossa: Sturmia inconspicuoides* Bar.; aus *Dasychira horsfieldii: Carceliopsis sumatrensis* Towns.; aus *Dasychira* sp.: *Carcelia modicella* (v.d. Wulp) und *Carcelia buitenzorgiensis* Bar.; aus *Stauropus alternus: Carceliopsis sumatrensis* Towns. und *Tricholyga sorbillans* (Wied.); aus *Caprina conchilialis* kenne ich kein parasitären Fliegen. Die meisten dieser Raupenfliegenarten können wegen ihrer grossen Ähnlichkeit sehr leicht miteinander verwechselt werden, besonders wo es sich um gezüchtetes Material handelt, da dieses meistens in sehr schlechtem Zustand in die Hände des Fachmannes gelangt. Und so glaube ich nicht, dass die Wirtsangaben von v.d. Wulp und Bezzi für das Wiedererkennen von *modicella* von grossem Nutzen sind. Von *C. modicella* (v.d. Wulp) (wie ich diese Art auffase) fand ich gezüchtete Exemplare mit folgenden Daten :—

Ex *Dasychira* sp., CEYLON : Heneratgoda, 27.vii.1931 (*Dr. J. C. Hutson*).

Ex *Notolophus posticus* Wlk., CEYLON : Kandy, 30.v.und 22.ix.1925.

Ex *Orgyia mendosa* Hübn., MALAYA : Topora, 9.iii.1927 und MALAYA : Kuala Lumpur.

Ex *Orgyia turbata* Butl., MALAYA : Prov. Hellesley.

9. *C. sumatrana* Towns. (15), p. 65, ♂.

Kopf goldiglicht, Orbiten dünkler goldig. Stirnbreite am Scheitel beträgt ein Sechstel der Kopfbreite. Wangen oben goldig, gegen unten weisslich. Clypeus, Facialien und Hinterkopf silbrig. Stirnstrieme dunkelbraun. Fühler schwärzlich, Taster gelblich. Hinterkopfbehaarung etwas gelblich. Thorax mit goldigem Reif und 5 schwarzen Längsstriemen. Schulterbeule, Schildchen, Seiten und Hinterrand des Thoraxrückens von rötlicher Grundfarbe. Abdomen rötlich, 5. Tergit und Mitte des 2. braun. Mittlere Segmente in der Mitte bräunlich. Die drei letzten Segmente dorsal goldig, ventral silbrig bereift. Beine braun, Schienen gelblich. Flügel längs der Adern etwas getrübt, an der Costa gelblich. Schüppchen gelblich. 3. Längsader mit 1 oder 2 Börstchen an der Basis. Körperlänge 10½ mm., Flügellänge 9 mm.

SUMATRA : Suban Ajam, vi.1916.

10. *C. rasella* Bar. (1), p. 44.

Ziemlich grosse Carcelie vom Aussehen einer *rasa* aber mit breiteren Paraloben und breiterer Stirn. Von *bombylans* R.D. unterscheidet sie sich durch das mehr langhaarige Haarkleid, von *lucorum* B.B. durch den breiteren Hinterleib und die grössere Dichte des Haarkleides, welches aus ganz gleichlangen Haaren besteht. — Stirnbreite beträgt am Scheitel zwei Drittel der Augenbreite. Stirnstrieme ziemlich breit aber schmäler als eine Orbite. Nur wenige herabsteigende, gedrängt und unregelmässig angeordnete Frontalborsten. Wangen und Backen von gleicher Breite und halb so breit wie das 3. Fühlerglied. Auf den Vibrissenleisten einige Haare über den starken Vibrissen. 3. Fühlerglied zweiundeinhalbmal so lang wie das zweite. Hinterleib mit mehr spärlichem aber gleichmässig verteiltem Toment, feinen Hinterrandbinden und ebensolcher Längsmittellinie. Die 2 Randborsten des 3. Hinterleibsringes nicht stark. Schienen hell; Hinterschienen an beiden Enden dünkler. Mittelschienen aussen vorn mit 1 Borste. Hinterschienen bewimpert, mit starker Zwischenborste.

Originalfundort : EUROPA :—FORMOSA (ohne genauere Daten).

11. *C. rasa* (Macq.) (11), p. 368.

Grosse Carcelie mit breitem Abdomen, feinem und dichtem Haarkleid. Charakteristisch für diese Art sind der lange und schmale Forceps und ebensolche Paraloben.—Stirn am Scheitel halb so breit wie ein Auge. Stirnstrieme schmäler als eine Orbite. Orbiten fein behaart. Herabsteigende Frontalborsten unregelmässig angeordnet, dicht stehend und zahlreich. Fühlerborste in beiden basalen Fünfteln deutlich verdickt. Auf den Vibrissenleisten über den Vibrissen mehrere feine Haare. Wangen und Backen schmal.

Randborsten auf dem 3. Hinterleibsring sind nicht deutlich ausgeprägt und etwas anliegend. Schienen hell, an den Enden dünkler. Mittelschienen aussen vorn mit 1 Borste. Hinterschienen bewimpert, ohne deutliche Zwischenborste.

Originalfundort: EUROPA.—Aus dem British Museum lernte ich zwei Exemplare mit folgenden Daten kennen: INDIA: Burma, Siddim, N. Chin Hills 5500 ft., i.1893 (*Capt. E. Y. Watson*) und JAVA: Idjen, 1400 m., Kendeng, 1924 (*Dammerman*).

12. **C. malayana** sp. n. ♂.

Stirn am Scheitel halb so breit wie ein Auge. Ozellarborsten stark entwickelt. Von reklinaten Frontalborsten sind links 3, rechts 2 vorhanden. Stirn im Profil etwas vorspringend. Gesichtsprofil länger als das Stirnprofil. 5 dichtstehende herabsteigende Frontalborsten. 3. Fühlerglied dreimal so lang wie das zweite. Wangen und Backen sehr schmal. Taster rötlich. Thorax schwarz, wenig, grau bereift, Schildchen rötlich.

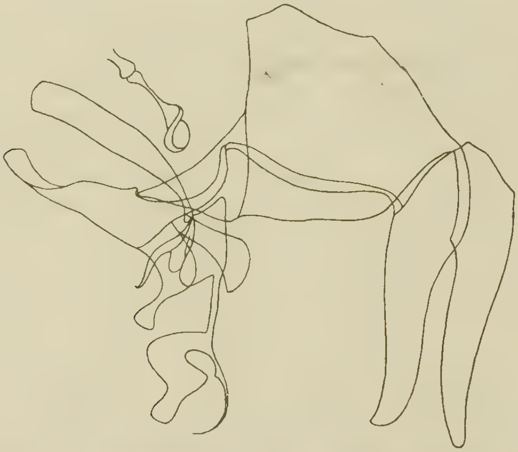

ABB. 3.—Terminalien des ♂ von *Carcelia malayana* sp. n.

Abdomen schwarz mit etwas gelblicher Bereifung, welche ungefähr zwei Drittel der Ringe einnimmt. Haarkleid des Abdomens borstig, jedoch nicht lang. 2. und 3. Tergit mit je einem Paar gut entwickelter mittlerer Randborsten. Flügel an der Basis gelblich, ebenso das Schüppchen. Beine schwarz, Klauen lang. Paraloben dicht und stark beborstet. Vordere Haken im Profil mit einer Verbreiterung am Ende, Penis (ebenfalls im Profil betrachtet) breit und kurz, mit zwei Klappen. Körperlänge 7 mm.

MALAYA. Nur 1 Exemplar aus dem Imperial Institute of Entomology in London, Typus im British Museum in London.

Parexorista B.B. (7), p. 87.
= *Senexorista* Towns. (15), p. 63.

Gatt.-Type: *Exorista cheloniae* Rond. (13), p. 138.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens lang, mit deutlichen Diskalborsten. Mittelschienen innen in der Mitte mit Borste. Hinterhüften hinten beborstet. Ozellarborsten vorhanden. Klauen des Männchens lang. Vordertarsen des Weibchens nicht verbreitert.

1. *P. sumatrana* (Towns.) (15), p. 63. ♂.

Kopf silbrigweiss, Orbiten bis zur untersten Frontalborste goldig. Stirnstrieme und Fühler schwärzlich. Taster gelb. Thorax mit spärlichem weisslichen Toment, Schulterbeule und Seiten des Thoraxrücken etwas goldig bestäubt; 5 schwarze Längsstriemen. Schildchen etwas rötlich, an der Basis schmal schwarz. Abdomen an den Seiten und auf dem Ventrum rötlich; Dorsalseite schwärzlich, die drei letzten Segmente mit silberweissen Basalbinden. Beine schwarz, Schienen rötlichbraun. Flügel in der Costalhälfte schwach getrübt. Schüppchen gelblich. Körperlänge 7½ mm., Flügellänge 6½ mm.

Originalfundort: SUMATRA: Fort de Kock, 1925.

Townsend beschrieb diese Art nur nach einem Männchen. Aus dem British Museum lernte ich jedoch ein Weibchen kennen, welches mit dem Typus vollkommen übereinstimmt.

CEYLON: Suduganga, 11.viii.1928 (*R. Senior-White*).

2. **P. latistylata** sp. n. ♂.

Orbiten, Wangen und Backen goldig, Clypeus und Facialien weisslich, Epistoma etwas rötlich. Thorax mit goldigem Toment, welcher besonders auf den Schultern deutlich ausgeprägt ist. Schildchen rötlichbraun. Abdomen glänzend schwarz, mit gelbem, nicht dichtem Toment, der den Glanz des Chitins nicht verdeckt. Längsmittellinie und schmale Hinterrandbinden auf dem 3. und 4. Tergit, sowie Apikaldrittel des 5. Tergites glänzend schwarz. Die Abdomenseiten etwas rötlich durchscheinend. Schienen dunkelbraun, im mittleren Drittel etwas heller. — Stirn am Scheitel halb so breit wie ein Auge. Orbiten anderthalbmal so breit wie die Stirnstrieme. 2 stark entwickelte reklinate, 3 herabsteigende Frontalborsten. Fühler lang, 3. Glied mehr als dreimal so lang wie das zweite. Stirn vortretend. Fühlerwurzel hoch oberhalb der Augenmitte. Wangen nach unten zu verschmälert. 2. und 3. Tergit mit je 1 Paar Randborsten. Mittelschienen aussen vorn mit 1 Borste. Flügel deutlich getrübt. 3. Längsader mit 3 Börstchen an der Basis. Körperlänge 8½ mm.

FORMOSA: Nur 1 Männchen.

Zygocarcelia Towns. (15), p. 64.

Gatt.-Type: *Z. cruciata* Towns. (15), p. 64.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens fein, ohne Diskalborsten. Mittelschienen innen in der Mitte mit Borste. Hinterhüften hinten ohne Beborstung. Behaarung der Augen weniger lang und dicht als bei allen anderer Gattungen des *Carcelia*-Komplexes. Ozellarborsten fehlend. Klauen des Männchens mässig lang. Innere Vertikalborsten gekreuzt.

1. *Z. cruciata* Towns. (15), p. 64, ♂.

Kopf messinggelb. Clypeus, Facialien und Hinterkopf silbrig. Stirnstrieme und Fühler schwärzlich. Taster gelblich. Thoraxrücken gelblich, Thoraxseiten weisslich bereift; 5 schwarze Längsstriemen. Schildchen schwärzlich, am Rande rötlich, gelblichgrau bereift. Abdomen schwarzbraun, an den Seiten und ventral die Basis des 3. Segmentes gelblichbraun. Die 3 letzten Segmente mit gelblichweissen Basalbinden, welche ungefähr die Hälfte der Segmente einnehmen. Beine bräunlichschwarz. Flügel an der Costa rauchfarben. Schüppchen gelblichgrau. Körperlänge 8½ mm., Flügellänge 7½ mm.

Originalfundort: SUMATRA: Air, Njuruk Bempo, 1440 m., viii.1916.— FORMOSA.

Carceliopsis Towns. (15), p. 66.

Gatt.-Type : *C. sumatrensis* Towns. (15), p. 66.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens fein, ohne Diskalborsten. Fünftes Abdominaltergit ohne auffallende Beborstung. Mittelschienen innen in der Mitte mit Borste. Hinterhüften hinten beborstet. Ozellarborsten vorhanden. Klauen des Männchens kurz.

1. *C. sumatrensis* Towns. (15), p. 66
= *Carcelia rasoides* Bar. (1), p. 42.

Mittelgrosse, gelblichgrau bereifte Fliege mit dichtem, kurzborstigem Haarkleid; Forceps, sowie Paraloben vom *excisa*-Typus, während der Penis ausgesprochen dreiklappig ist und keinen Basalzahn besitzt. — Stirn am Scheitel halb so breit wie ein Auge, abgerundet. Wangen und Backen schmal. Ozellarborsten sehr fein. Herabsteigende Frontalborsten nicht dick, von variierender Anzahl und zuweilen unregelmässiger Anordnung. Abdomen an den Seiten rötlich durchscheinend. Toment des Abdomens ziemlich dicht. Hinterrandbinden nicht scharf begrenzt. Schienen hell, an den Enden dünkler. Hinterschienen dicht bewimpert, mit Zwischenborste, welche ebenso lang, jedoch dicker wie die Wimperborsten ist. Klauen des Männchens kurz.

Originalfundort : Sumatra : Fort de Kock, xii.1920.—Formosa : Kankau, vi. und ix.1912 (*H. Sauter*).

Von gezüchteten Exemplaren sind mir folgende Daten bekannt :—

Ex *Stauropus alternus* Wlk., Ceylon : Ratnapura, 6.ii.1920 und Ceylon : Yatiyantota, 4.x.1912.

Ex *Dasychira horsfieldii*, Malaya : Kuala Lumpur, 11.i.1932.

Isocarceliopsis gen. n.

Gatt.-Type. *I. hemimacquartioides* sp. n.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens borstig, mit deutlichen Diskalborsten. Mittelschienen innen in der Mitte mit Borste. Hinterhüften hinten beborstet. Klauen des Männchens sehr kurz. Ozellarborsten vorhanden. Drittes Fühlerglied ungemein lang. Vordertarsen des Weibchens nicht verbreitert.

1. **I. hemimacquartioides** sp. n. ♂, ♀

Kleine, schwarze, schmal gebaute Fliege, welche *Isocarcelia inconspicua* Villeneuve am nächsten steht. — Stirnbreite beträgt am Scheitel zwei Drittel der Augenbreite. Stirnstrieme schmäler als eine Orbite. 3 herabsteigende Frontalborsten. Wangen schmal, Backen doppelt so hoch als breit. Fühler sehr lang; 3. Fühlerglied an der Basis doppelt so breit wie das 2., welches kurz ist. Fühlerborste sehr hoch inseriert, in den beiden basalen Fünfteln verdickt. Taster gelb. Thorax wenig bereift. Schildchen schwarz, nur an der Spitze rötlich. Die gekreuzten, aufgerichteten Apikalborsten sind fein. Abdomen schwarz, mit weisslichen Basalbinden und echten Diskalborsten. Beine schwarz. Hinterschienen schwarzbraun. Flügel etwas gebräunt. Hintere Querader steiler und weniger gebogen, sowie 1. Hinterrandzelle schmäler offen als bei *inconspicua*, daher auch die Spitzenquerader weniger gebogen. Körperlänge 5½ mm.

Formosa : einige Exemplare im Deutschen Entomologischen Institut in Berlin-Dahlem.—Tainan, iv.1910 und Takao, xii.1907 (*H. Sauter*); Museum in Stettin.

Asiocarcelia gen. n.

Gatt.-Type : *Carcelia caudata* Bar. (1), p. 41.

Thorax mit 4 Dorsozentralborsten hinter der Naht. Haarkleid des Abdomens sehr kurz und dicht. Fünftes Tergit ventral und dorsal dicht und buschig beborstet. Mittelschienen innen in der Mitte mit Borste. Hinterhüften hinten beborstet. Klauen des Männchens kurz oder nur mässig lang. Ozellarborsten fehlend.

1. *A. caudata* (Bar.) (1), p. 41.

Mittelgrosse, sehr schöne Fliege mit glänzend schwarzem, dicht beborstetem, buschigem letzten Hinterleibsring. — Stirn am Scheitel halb so breit wie ein Auge. Stirnstrieme schmal. Ozellarborsten fehlend. Orbiten mit ganz feinen Härchen dicht besetzt. 3 reklinate Frontal borsten. Stirn abgerundet. Wangen und Backen sehr schmal. Haar kleid fein, dicht. Toment auf dem 3. und 4. Hinterleibsring von seidenartigem Glanz. Beine schwarz; Hinterschienen bewimpert, mit Zwischenborste. Klauen des Männchens mässig lang. Paraloben lang, an der Basis breit, dann sich stark verjüngend, mit dünn ausgezogenem Endteil. Forceps an der Spitze etwas dorsalwärts gebogen. Hintere Haken dünn, stabförmig. Vordere Haken so lang wie die hinteren aber sehr breit.

Originalfundort : Formosa : Kankau, viii.–ix.1912 und Toa-Tsui-Kutsu, v.1914 (*H. Sauter*).—Mehrere Exemplare aus dem British Museum in London : Ceylon : Suduganga, 5.ii., 10.iii., 2.iii.1918, 19.v.1919 (*R. Senior-White*).

2. **A. pseudocaudata** sp. n.

Von *caudata* sonderte ich ein Exemplar, welches einige Unterschiede aufweist, als *pseudocaudata* sp. n. ab, lasse jedoch diese Art in meiner Bestimmungstabelle unberücksichtigt, das das 5. Tergit unsymmetrisch entwickelt ist und es sich vielleicht nur um ein abnormales Exemplar von *caudata* handelt. Erst wenn mir noch andere Exemplare mit denselben Besonderheiten vorliegen werden, kann ich entscheiden ob diese Art zu Recht besteht. Diese Besonderheiten sind folgende : Schienen dunkelrot mit schwarzen Enden; Klauen der Vordertarsen beim Männchen etwas länger als das letzte Tarsenglied, also länger als bei *caudata*; 5. Abdominaltergit deutlich bereift, jedoch nur auf einer Seite.

3. *A. caudatella* (Bar.) (2), p. 1, ♂.

Unterscheidet sich von *caudata* durch die dünklere Farbe, durch das Vorhandensein von nur 2 reklinaten Frontalborsten und durch die geringere Anzahl der übrigen Frontalborsten; Schildchen schwarz, Augen sehr fein behaart, Flügel getrübt, Klauen des Männchens ganz kurz, Körperbereifung bläulichweiss. Körperlänge 10 mm.

W.-Sumatra : Siberut Island, ix.1924 (*C.B.K.* and *N.S.*).

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ON SOME FURTHER REMARKABLE STRUCTURES IN TRICHOPTERA

By H. Eltringham, M.A., D.Sc., F.R.S.

[Read, 4th April, 1934.]

With Plate XV.

The smaller Trichoptera appear to afford an inexhaustible field for histological research. It is now some fifteen years ago since the Society published my figures and descriptions of the complex scent-organs discovered by my friend Mr. Martin E. Mosely, in the heads of male Trichoptera of the genus *Hydroptila* (1919, *Trans. ent. Soc. Lond.*, **1919** : 420). From further material kindly supplied by that indefatigable worker I was able to give an account of the tracheal vesicles in the genera *Diplectrona* and *Agapetus*, and at the same time to describe the lateral glands found in *Agapetus* (1931, *loc. cit.*, **79** : 539). Many of these small Trichoptera have lateral or ventro-lateral filaments in, so far as at present known, both sexes, and it seemed worth while to discover whether these filaments are correlated to any internal structure.

In the course of the investigation, which has involved the making of thousands of sections and other preparations, structures other than lateral glands have been observed, and the most convenient method of dealing with them would appear to be to take each species of which material has been available, and to describe the features of interest found therein.

Diplectrona meridionalis Hagen.

In the paper above referred to (1931), I stated that I had not yet found lateral glands in *Diplectrona*, the only species of that genus then available being *D. felix*. Careful re-examination of my sections discloses the fact that the gland is actually present, though it is only after comparison with the more favourable material provided by *D. meridionalis* that I have been able to recognise it. Whether the organ is less developed in *felix* than in *meridionalis*, or whether it is a question of better preserved material, I am unable at present to decide. Both *felix* and *meridionalis* have lateral filaments. Plate XV, fig. 1, is a drawing of the 4th and 5th segments of the abdomen of a male of *meridionalis* seen from the ventral surface. The filaments are chitinous tubes, open at the extremities, and having a delicately reticulated cuticle. In partially cleared specimens the gland can be seen through the abdominal cuticle, and dissection shows the relation between it and the filaments, which I have depicted at fig. 2. The gland itself is a more or less reniform mass of cells, G, from which there pass numerous fine ducteoles leading to a reservoir, R, which communicates with the filament F. A section through the entire apparatus, and still more magnified, is shown at fig. 3, which is a partial reconstruction from a number of serial sections. The gland, G, is composed of a number of typical secreting cells, apparently embedded in a mass of vacuolated tissue. Each has a fine ducteole leading to the reservoir R, from which the main duct, D, leads directly into the filament F. Inside the filament, and near its base, is a muscle, M, and it is interesting to note that the duct passes round and under this muscle. Apparently contraction of the muscle would bring the filament more nearly into a position parallel with the long axis of the body, and at the same time close, by pressure, the lumen of the duct. This action, if correctly interpreted, is contrary to what we should have expected, since what may be supposed to be the active condition of the organ, is associated with the expansion, instead of contraction, of the muscle. As, however, we do not know the function of the gland nor the conditions under which it is employed, we have at present little ground for discussion on its activity. A similar gland is probably present in the female, but I have at present no material of that sex.

Polycentropus flavomaculatus Pict.

This species also has lateral projections on both sexes. Fig. 5 is a drawing from a partially cleared example, showing that the filament, F, is of a different outward form, and much more laterally placed than in *Diplectrona meridionalis*. The gland can be seen through the translucent cuticle, and its duct easily traced. The structure of the gland itself is very similar to that of *D. meridionalis*. At fig. 4 I have shown a few of the gland-cells, highly magnified. Each shows a granulated protoplasm with a small nucleus and numerous vacuoles, while the ducteole communicates with a large spherical area in the middle of the cell, in which I have so far been unable to detect the radial striation so commonly found in gland-cells of this not unusual type. For some time I was under the impression that these lateral glands were a secondary sexual characteristic, and to be found only in the males. So completely is the female abdomen filled by the ovarian tubes and their contents, that other organs tend to be much displaced and obscured. Careful examination of a series of sections of *P. flavomaculatus* convinces me, however, that the glands are in fact present in the female of this species. They seem much reduced and there is less evidence of the ducteoles which are so characteristic a feature of the same organs in the male. Furthermore, fresh material of *Diplectrona felix*, kindly supplied by Mr. Mosely, has provided additional sections of a female abdomen, and though I have not been able to distinguish the gland as a complete entity, there are, amongst the compressed and displaced organs, numerous cells, having such a characteristic appearance that I suspect the existence of the gland in the female of this species also. The evidence at present seems to point to its presence in the majority of the species examined, and probably in both sexes.

Glossosoma boltoni Curt.

A conspicuous external feature of the male of this species is a thickened patch near the base of the fore-wing. Its position is indicated at fig. 6, P. The neuration at this point is considerably distorted. Under a much higher power the structure is seen as at fig. 7. On the underside of the wing is a large inflation, though no definite correlation of this structure to the remainder of the organ is evident. The scent-organ, for such it would appear to be, is formed by a small fold, F, of the wing-membrane, recurved towards the thorax. The edge of the fold is thickly set with two types of special scales, one of the forms being shown at fig. 8, and the other at fig. 10. These scales become detached very easily and are probably much more numerous in living than in preserved material. Judging by the number of sockets they probably, in life, cover the whole organ. Both types of scale are longitudinally striated and that shown at fig. 8 is fringed. On the adjoining nervures a third type of scale is found. This is represented at fig. 9. It is much longer than the others and fringed, usually only on one side. A longitudinal section through the whole organ shows, as at fig. 11, the folding of the wing-membrane, with the scales, S, and finer projections, P, on the inner part of the fold. At fig. 12 the minute structure of the organ is shown under a very high magnification. M 1 is the thickened wing-membrane containing a mass of cells, presumably of a glandular nature. At P is one of the slender projections, now seen to be a modified scale. This has the appearance of having been rather similar to one of the marginal scales (fig. 8) but to have lost some of its striae. It arises from a socket, S, of peculiar form, the outer edge of which is helical. The scale-stalk expands in the inner part of the socket and then contracts, only to expand again where it is embedded in the secreting cells. M 2 shows the wing-membrane in that part of the fold opposite the glandular portion. It exhibits a regular series of more or less hemispherical concavities, from the bottom of each of which arises a pointed projection. This formation seems admirably adapted to retain the secretion doubtless exuded from the glandular portion of the membrane. Probably the fringed scales act as distributors of the secretion. *G. boltoni* does not show any development of the glandular filaments found in some other species, nor have I been able to find lateral glands in either sex. The sixth sternite of the male is produced ventro-laterally into two slight projections, and there is a central, broadly spatulate appendage, followed by a minute projection on the eighth. In the female there is only a rudiment of the spatulate process. Sections do not show any internal apparatus in connection with these structures.

Beraea maurus Curt.

This very small species has no filaments, but in the male there is a slender central chitinous projection on the ventral surface of the seventh segment. The female has a rudiment of the same structure. I have not found any lateral glands. The most interesting feature is a minute organ at the base of the male fore-wing. The whole wing is only about 3 mm. in length, and the organ is barely visible to the unaided eye. Plate XV, fig. 15, is a surface view of the base of the wing under a moderate power. The structure has the appearance of a small capsule, C, containing elongated, darkly pigmented bodies, in shape rather suggestive of a bunch of bananas. They do not clear very well, nor are they easily depigmented, resisting long immersion in diaphanol. Longitudinal sections are so small that there is difficulty in making them adhere to the slide, but a few good examples were obtained, and fig. 16 shows the structure of the organ in section, as seen under a high power. It is a pocket or fold of the wing, recalling, in form, the pockets found in the hind-wings of some Lepidoptera (DANAINAE). The covering flap or fold, F, is extremely thin, but has a thickened edge at E. The pocket is lined with very curious scales. In the section illustrated these scales arise mainly from one side of the pocket, but in some sections both sides are scaled, the distal ends of the scales meeting in the centre. In the wing-membrane there is a layer of modified hypoderm which is probably glandular. The scales themselves are of such an unusual nature that their identification as such was not at first apparent. Under the oil-immersion objective they appear as shown at fig. 17. There is a very faint longitudinal striation and a slight dotting between the striae. The scales are very thick, and fig. 18, which illustrates several in transverse section, shows that the shape is quite irregular. Their most remarkable feature, however, is the internal canal which appears to have a concentric globular form at G, fig. 17, produced into an arborescent structure, C, extending to the extremity of the scale. Each is inserted in the glandular wing-membrane, M, in a very simple form of socket.

It would seem that we have in this structure a glandular scale. Such an organ is quite unknown to me in any other insect scent-organ. The wing bears, in addition, large numbers of special scales, indicated at S, fig. 15, and a single scale more highly magnified is shown at fig. 19. These scales may possibly have a distributive function.

Ecclisopteryx guttulata Pict.

On the male hind-wing there is a minute brush, the position of which I have indicated at B on the diagram at fig. 13. Sections of this part of the wing do not show any modification of membrane or nervures which could certainly be regarded as glandular. There are a few minute cells at the bases of the brush-hairs and in the adjoining nervures, but these show no special development. So far this brush is rather a mystery as it seems to be unaccompanied by any ancillary structures.

Neither sex has lateral filaments, but the male has in the fifth segment very highly developed lateral glands. They open to the exterior through a cuticular pore, and are remarkable in being of an entirely different structure from the other lateral glands so far examined. Comparatively large, they can be dissected out and sections made without the remainder of the abdomen. Fig. 14 shows such a section of one of the glands, very near to the junction of its short duct with the exterior. The gland-cells, G, are not rounded and irregularly massed together, nor have they any ducteoles. Mainly in a single layer, they are regularly arranged, and show nuclei very uniformly distributed in the peripheral area. Many sections show a more or less irregular mass of an amorphous substance, fig. 14, A, in the lumen of the gland. This is probably a congealed secretion. In the figure, G is the gland and C the external ventro-lateral cuticle. I have no sections of the female.

The study of the complex histological details of these small insects provides a convincing demonstration of the purely relative conception of size. The elaborate scent-apparatus in the heads of species of *Hydroptila* (1919, *Trans. ent. Soc. Lond.*, **1919** : pl. 22), the whole head being barely a fiftieth of an inch across, furnishes an example of the wealth of histological detail which may occur in a small space, but the organ in the wing of *B. maurus* carries the interest even further. The whole organ occupies an area of about ·008 sq. mm. The length of an average scale is ·04 mm. and the diameter of its stalk ·0025 mm. To our ideas the effect of such an organ as the source of perceptible odours, might well appear negligible, nevertheless its existence and high development argue an important function.

The use of the lateral glands in some of the species remains problematical. They appear to occur in both sexes, though not equally well developed. Insect glands, similar in structure and position and common to both sexes, are usually of a protective character. We even have, as in *Heliconius* (1925, *Trans. ent. Soc. Lond.*, **1925** : 269), undoubted repulsive glands in both sexes, but in different positions in the body of the two sexes. The obvious necessity for greater protection for the female would demand a higher development of such organs in that sex, but in these small glands in Trichoptera, where such glands have been observed, they are less developed in the female than in the male. Observations of the insects in life are difficult, owing to their small size and inconspicuous appearance. It is hoped, however, that knowledge of their complex structure will encourage those who have the opportunity to persevere in a field which promises such interesting disclosures. Such work should not be more difficult than that carried out by one of our Fellows, Mr. A. H. Hamm, whose painstaking observations resulted in the discovery of the almost unique silk-spinning apparatus in flies of the genus *Hilara*.

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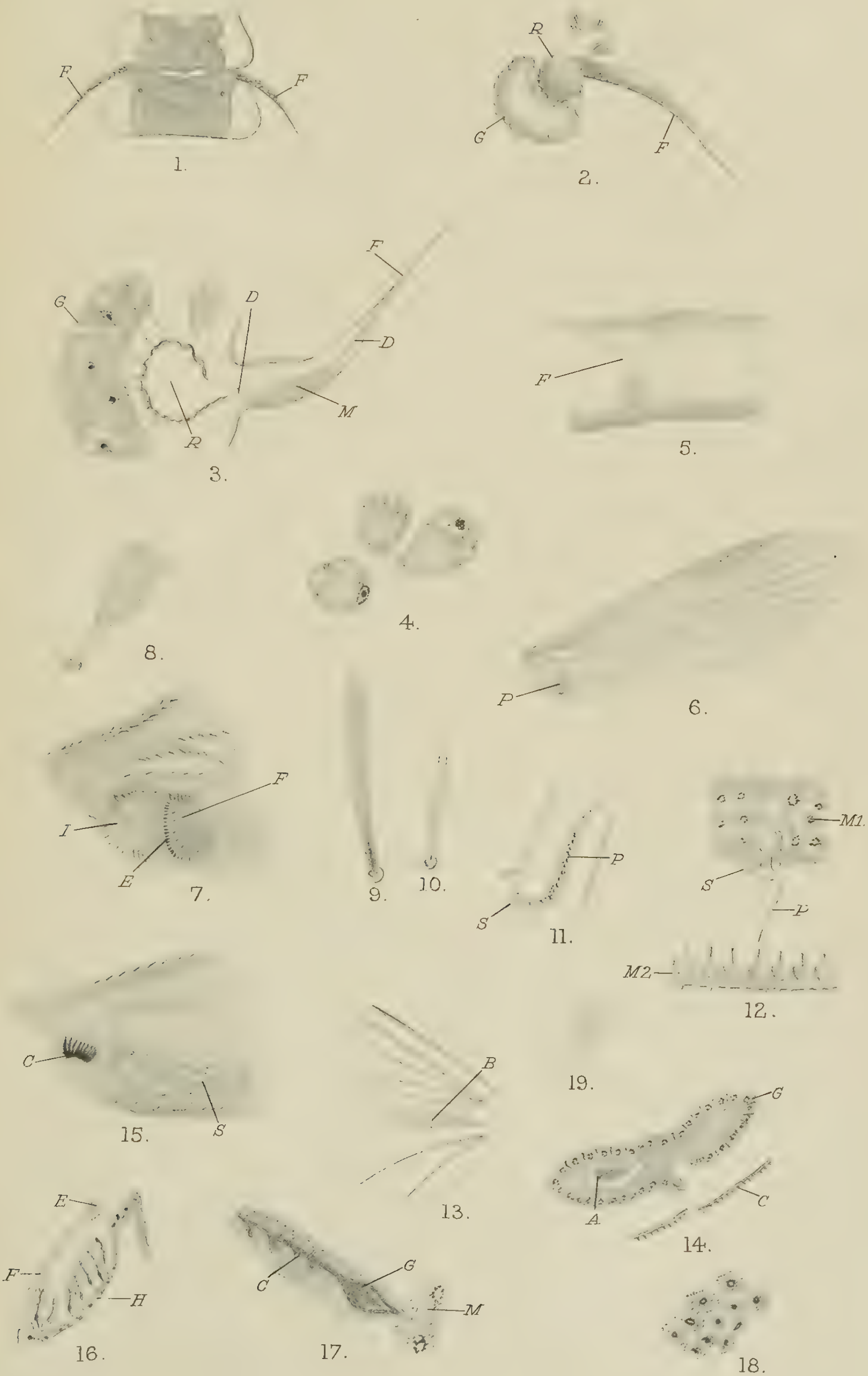
Explanation of Plate XV.

Fig. 1. *Diplectrona meridionalis* ♂, 4th and 5th abdominal segments, viewed from beneath. F,F, filaments.

2. Ditto. The gland, reservoir, and filament dissected out and more highly magnified. G, gland, R, reservoir, F, filament.
3. Section through gland, etc., still further magnified. G, gland, R, reservoir, D,D, duct, M, muscles, F, filament.
4. *Polycentropus flavomaculatus* ♂. Three cells from the lateral gland highly magnified.
5. Ditto. Part of abdomen, cleared, and showing the lateral gland as seen within, and the duct leading to filament, F.
6. *Glossosoma boltoni* ♂. Fore-wing showing position of scent-organ at P.
7. Ditto, more highly magnified surface view of the wing-gland. I, inflated vesicle. E, edge of fold with special scales. F, fold of wing-membrane.
8. Ditto. A fringed scale from the wing-organ.
9. Ditto. A special scale from the nervures and surfaces adjoining the wing-organ.
10. Ditto. A special scale of a type different from that shown at fig. 8, also taken from the wing-organ.
11. Ditto. Longitudinal section of wing-organ. P, fine projections on inside of fold. S, scales.
12. Ditto. Section of part of wing-organ, highly magnified. M 1, thickened membrane with glandular cells. S, scale socket. P, modified scale. M 2, wing-membrane opposite glandular portion.
13. *Ecclisopteryx guttulata* ♂. Diagram of base of hind-wing showing position of brush, B.
14. Ditto. Section of lateral gland. G, gland. A, congealed secretion. C, external abdominal cuticle.
15. *Beraea maurus* ♂. Base of fore-wing with scent organ, C, and special scales, S.
16. Ditto. Section through scent-organ, highly magnified. E, thickened edge of covering fold. F, covering fold. H, glandular hypoderm.
17. Ditto. One of the scales from the scent-organ, more highly magnified. C, internal canal. G, basal expansion of same. M, glandular portion of wing-membrane.
18. Ditto. Transverse sections of scales of the scent-organ.
19. Ditto. One of the special scales found on both fore- and hind-wings.

The magnifications vary. Actual sizes of some of the parts are:

Fig. 8. Length of scale, 0·04 mm.; fig. 12. Thickness of membrane, M 2, 0·01 mm.; fig. 14. Greatest width of gland, 0·4 mm.; fig. 17. Length of scale, 0·04 mm.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STRUCTURES IN *TRICHOPTERA*.

A STUDY OF THE COLONISATION OF *APHELINUS MALI* HALD.

By H. T. Rosenberg, B.Sc., A.R.C.Sc.

(Farnham House Laboratory, Imperial Institute of Entomology.)

J.M

[Read 3rd October, 1934.]

With Two Text-figures.

Aphelinus mali Hald., the Chalcid parasite of *Eriosoma lanigerum* Hausm., is bred continuously at the Farnham House Laboratory, in order that persons whose apple trees are infested with Woolly Aphis may be supplied with the parasite. During the early summer of 1933, Mr. Clive F. Uzielli, of Buckleberry, Berks, asked for supplies of *Aphelinus*, and a colony was put in his orchard on 7th June, 1933. Buckleberry being within easy reach of the Laboratory, advantage was taken of this liberation to obtain data on the rate of spread of the parasite through the orchard, from the original points of introduction.

Mr. Uzielli's property at Buckleberry comprises two orchards: one is small, containing about forty trees of various varieties; the crop, though frequently large, is of little value. At the time of the writer's first visit there was a considerable, but not catastrophic, population of *Eriosoma* in this orchard. One hundred Aphids were collected and afterwards dissected, being found to contain no parasites. Subsequently no attention was paid to this orchard. The larger orchard, of two hundred and sixty trees, includes some 150 Cox's Orange Pippins, the remainder being Newton Wonder, Newton Pippin, Blenheim, Wellington, and Miller's Seedlings. There was in this orchard, at the beginning of June, a severe infestation of Woolly Aphis. The colonies of Aphids had some time previously been painted with paraffin, which had checked the pest, but the Aphis were now rapidly increasing in numbers. The infestation was most severe on the Cox's Orange Pippins, some trees of other varieties being almost free; most of the Aphis colonies were on scars and cracks in bark of the branches; very few were found on the trunks. The trees are mostly from 30–40 years old (although a few of the original trees have been replaced), and are planted about five yards apart; thus, in most parts of the orchard, the branches of one tree reach those of its neighbours, so that a parasite of a widespread insect has only short distances to fly before finding new colonies of hosts. It was in this orchard that parasites were liberated and observations made during the following months. In addition to these two orchards, there is a row of espalier trees (Bramley Seedlings), of which the nearest is ten yards from the large orchard.

A plan of the orchard was made (fig. 1) on which the rows of trees were marked by letters, and the trees in each row by numbers. Three hundred Aphids were collected, and when afterwards dissected, were found to be free from parasites. Twigs, each bearing approximately 100 parasitised Aphids, were fastened to various heavily infested trees throughout the orchard, as shown in fig. 1, single twigs being placed on each of thirteen trees, and five twigs on tree N 11. The orchard as a whole was observed at intervals of a week or a fortnight from 7th June until 28th September; and during this period dissections were made of Aphids from two colonised trees, T 2 and N 11, and two uncolonised trees, Q 2 and K 14. Q 2 is 16 yards from T 2, with an almost continuous canopy of leaves between them; there is no other colonised tree within 25 yards of Q 2. K 14 is 16 yards from N 11, and, being a young tree, is more isolated from its neighbours than is Q 2; other colonised trees are situated 13 yards and 20 yards from K 14. The following table shows the results of dissections from these trees:

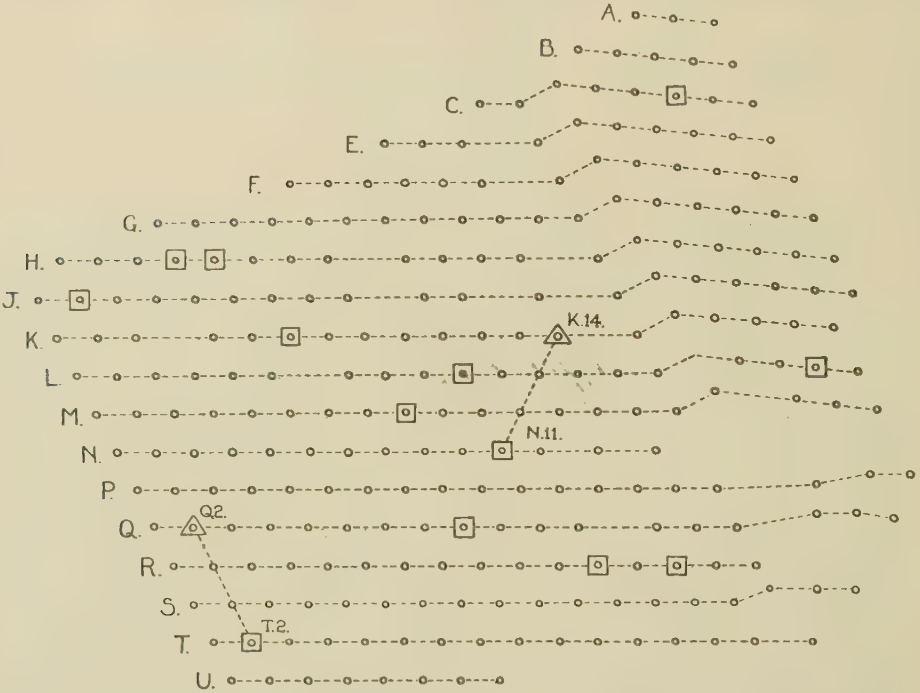

Fig. 1.—Plan of orchard at Buckleberry. Trees are shown as small circles; circles enclosed by squares indicate trees on which colonies of *Aphelinus* were placed; circles enclosed by triangles indicate trees from which collections were made.

Date.	T 2.		Q 2.		N 11.		K 14.		Other trees.	
	Hosts.	Para-sites.	Hosts.	Para-sites.	Hosts.	Para-sites.	Hosts.	Para-sites.	Hosts.	Para-sites.
7.vi.33	35	0			100	0			165	0
22.vi.33	27	2			50	1			83	0
6.vii.33	25	0	25	0	35	1	30	0	320	0
13.vii.33	50	3	50	0	50	0	50	0		
20.vii.33	50	8	50	0	80	19	30	0		
27.vii.33	50	16	50	0	50	0	50	0		
3.viii.33	50	5	50	0	50	14	50	0		
10.viii.33	50	26	50	4	50	28	50	1		
17.viii.33	50	40	50	2	50	33	50	15		
24.viii.33	50	36	50	10	50	43	50	37		
31.viii.33	50	40	50	37	50	47	50	47		
11.ix.33	(19	19)	50	42	50	50	50	49		
28.ix.33	(4	3)	50	43	(23	23)	50	49		

It was found that the parasites tend to remain within a foot or two of the point of emergence from their host, if plenty of Aphids are present. In consequence, colonies of Aphids, close to the points where the original colonies of parasites were fastened, rapidly became reduced in numbers, and disappeared, while other colonies on the same trees were unparasitised. This fact was not realised at first, and specimens for dissection were collected from only a few points on each tree; to this is attributable the irregularity of the earlier parts of the curve of parasitism. The later collections were made from 10 points distributed throughout each tree.

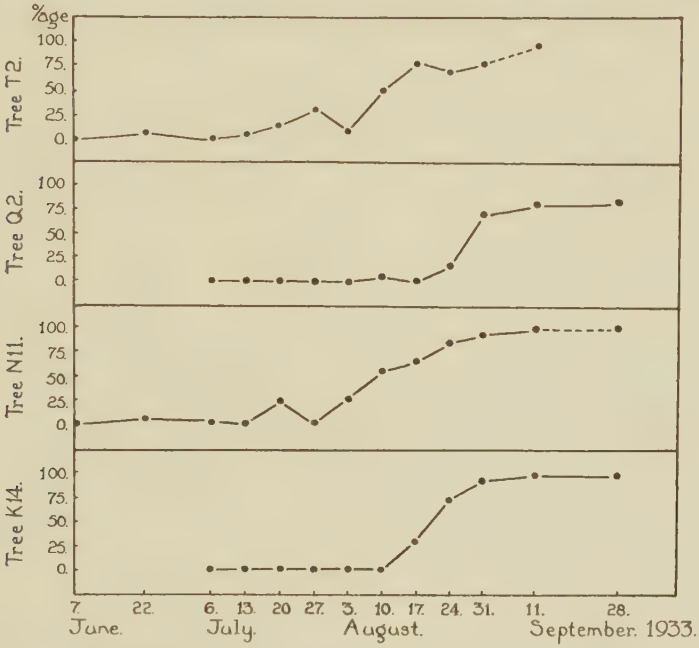

Fig. 2.—Graphs showing percentage of parasitism on two colonised and two uncolonised trees.

Between the first and second inspection, heavy rain had occurred. This had washed away some of the wool from the Aphids, but, notwithstanding this, they were seen to have increased in numbers considerably; this increase was noticeable chiefly on young shoots. Three adult *Aphelinus* were observed on this occasion. The population of Aphids continued to increase until about the middle of August; the increase was especially noticeable on Newtons, which, at the beginning of June, were almost free from Aphids. By 27th July, 1933, Aphid colonies within six inches of the original centres of liberation of parasites had been destroyed. On 10th August, 1933, many adult parasites were seen on colonised trees, and on trees adjacent to these. One week later, the blackened skins of parasitised Aphids were commonly seen, both on the colonised trees and on adjacent trees. The Aphis population was certainly smaller than it had previously been on colonised trees. On 31st August, 1933, it was noticeable that there had been a marked decrease in Aphid infestation, especially on colonised trees; it was difficult to find 50 specimens for dissection on T 2. On 28th September, 1933, only four living Aphids were found on T 2, and it was impossible to collect 50 from N 11. A few new colonies of Aphids had appeared on Q 2; but in the orchard as a whole, the infestation was slight and not of economic importance.

The only other insects observed preying on Woolly Aphis were Syrphid larvae, subsequently identified as *Syrphus balteatus* Deg. and *S. auricollis* Mg. On no occasion were Syrphid larvae seen in the field, since they become covered with wool and are difficult to distinguish; but when the twigs were brought into the laboratory the larvae were found. The following table shows the number of larvae found, and the total number of twigs collected on various dates:

Date.	No. of Syrphid larvae.	No. of twigs collected.
20.vii.33 . . .	4	22
27.vii.33 . . .	1	22
3.viii.33 . .	4	20
10.viii.33 . .	2	18
17.viii.33 . .	5	29
24.viii.33 . .	2	40

No Syrphids were found after 24.viii.33. No data were obtained as to the number of Aphids consumed; but since the Syrphid larvae were present, as the above table shows, on some 12 per cent. of the twigs collected on these dates, they evidently were of considerable importance in the control of the Aphids. The Aphids were also attacked by a spotted woodpecker. A single parasite larva was obtained by dissection from an Aphid; this larva closely resembles that of *Praon simulans* Prov., as figured by Timberlake, 1910. In this connection it may be noted that Waterston, 1926, recorded *Praon lepelleyi* Waterst. (Hym. BRACONIDAE) as a parasite of *Eriosoma lanigerum* Hausm. in England.

So it appears that the decrease in the Aphid infestation is due to the increase in *Aphelinus* population, aided in some degree by the presence of Syrphids: unless such a decrease in Aphid infestation is normal and would have occurred in the absence of *Aphelinus*. Woolly Aphis individuals are known to migrate to the roots of apple in the autumn, and it might be suggested that this migration was in progress at the end of September. The roots of the trees were not searched for Aphids at this time, but the Aphid colonies on the branches appeared normal, with young and half-grown individuals present. (It had been noticed that as the *Aphelinus* population increased, the number of very old Aphids on the trees decreased.) Further, some apple trees at Wimbledon, Surrey, were observed throughout this year; no *Aphelinus* were present, and a severe infestation of Woolly Aphis was seen on the branches until the beginning of November, with no obvious diminution. No visits were paid to Buckleberry after 28th September, 1933, but twigs, bearing Aphids, from the row of espalier trees mentioned above, were received on 15th November, 1933. The twigs were from the tree nearest to the large orchard, which had been under consideration, and distant about 10 yards from it. In an accompanying letter, Mr. Uzielli stated that although the main orchard was quite clean at this date, all the espalier trees were fairly badly infested and still looked woolly. The twigs examined bore numerous Aphids in various stages of development (though perhaps rather fewer young Aphids than would have been found earlier in the year); on dissection, 19 of 64 Aphids were discovered to be parasitised by

Aphelinus, all stages of the parasite from egg to pupa being found. Thus it seems that a considerable period elapsed before *Aphelinus* reached the espalier trees from the main orchard, 10 yards away; and that the absence of the parasite from these trees during the summer enabled the Aphids to continue unchecked until late in the year, although it may be presumed that Syrphid larvae were present. The observations on these trees and on those at Wimbledon render it highly unlikely that the sudden decrease in Aphis infestation during August and September was due to any factor other than the presence of *Aphelinus*.

In considering the dates given above, it must be remembered that the summer and autumn of 1933 were unusually warm and sunny. Lundie (1923) states that the *Aphelinus* hibernates as a full-grown larva within the skin of its host, on the stem of the tree and under stones and leaves on the ground. No hibernating larvae were found at Buckleberry. Cases have been reported in England, where *Aphelinus* has been a successful parasite in the year of liberation, but has died out during the winter. The facts that no hibernating parasites were seen, and that Aphids containing parasite eggs, larvae, and pupae, were found in mid-November at Buckleberry, suggest the possibility that *Aphelinus* is not completely adjusted to the climate of this country; that larvae do not assume the hibernating form, but give rise to adults when no hosts are available for oviposition, and that in consequence the *Aphelinus* population dies during the winter. Further information is desirable on this point.

Some suggestions may be made, as a result of these investigations, on the methods to be adopted in future liberations of *Aphelinus*. At Buckleberry, at the beginning of June, Aphids were present in very large numbers, and it was impossible for the *Aphelinus* to cope with the infestation before considerable damage had been done. It therefore appears desirable that colonies of the parasite should be put in orchards by the beginning of May, if it is likely that Woolly Aphis will be a serious pest; if this is done, the parasite should obtain control much earlier in the year than if the liberation is left until June. Seventy-five per cent. control was obtained on trees 16 yards from the original centre of parasitism, shortly after the same degree of parasitism was reached on the trees originally colonised, thus it seems that, in an orchard of trees planted five yards apart and large enough for an almost complete canopy of leaves to be formed, it should be ample to place a unit of approximately 100 *Aphelinus* larvae on every fifth tree, in every fifth row. With such treatment no tree is more than 15 yards from a colony. As was found with the espalier trees at Buckleberry, trees which are separated from the main orchard by even a few yards need to be separately colonised if adequate control is to be attained early in the season. It has been suggested that, some weeks after colonies of *Aphelinus* are put out, twigs from colonised trees should be distributed throughout the orchard, in order to spread the parasite rapidly. When a sufficient supply of *Aphelinus* is not available, this practice may be desirable, but it is probable that only a small number of parasitised Aphids will be on each of such twigs; and even if there are a hundred on each, parasitism in each new focus will increase slowly, as it did on trees T 2 and N 11. When a unit of one hundred *Aphelinus* for every twenty-five trees is available the effect of this distribution of infested twigs will be negligible.

I am indebted to Dr. W. R. Thompson, F.R.S., who suggested this investigation to me, and advised me during its progress; to Sir Guy A. K. Marshall, C.M.G., F.R.S., for the determination of the Syrphid predators; and to Mr. Clive F. Uzielli for his co-operation during my visits to Buckleberry.

SUMMARY.

1. A description is given of the orchard in which the investigation was carried out.

2. The rate of increase of parasitism by *Aphelinus* is shown.

3. Predators of *Eriosoma lanigerum* at Buckleberry include *Syrphus balteatus* Deg., *S. auricollis* Mg., and a spotted woodpecker. A parasite, believed to be *Praon* sp., was found.

4. Suggestions are made of methods to be used in future liberations of *Aphelinus*.

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THE GENUS *PINTALIA* STÅL (HOMOPTERA, CIXIIDAE)

By the late FREDERICK MUIR, D.Sc.*

[Read 3rd October, 1934.]

WITH THIRTY-ONE TEXT-FIGURES.

Pintalia Stål.

Pintalia Stål, 1862, Svensk. Vet. Akad. Handl., **3** (6) : 4. Type *P. lateralis* Stål. Stål, 1866, Hem. Afr., **4** : 165. Muir, 1925, Pan-Pac. Ent., **1** : 103, 106.

Cotyleceps Uhler, 1895, Proc. zool. Soc. Lond., **1895** : 63. Type *C. decorata* Uhler. Muir, 1925, *op. cit.*, p. 100.

Metabrixia Fowler, 1904, Biol. cent. Amer. Homoptera, **1** : 80. Type *M. delicata* Fowler. Muir, 1925, *op. cit.*, p. 100.

Ciocixius Metcalf, 1923, J. Elisha Mitchell sci. Soc., **38** : 183. Type *Cixius dorsivittatus* Van Duzee. Muir, 1925, *op. cit.*, p. 100.

THIS genus was erected by Stål for nine species from Rio Janeiro; of these *consobrina* and *ustulata* are not typical. In 1869 Stål placed *Flata variegata* Fabr. from the West Indies into this genus. In 1890 Lethierry described *Pintalia discoidalis*. There appears to have been no further recognition of the genus until Muir, 1925, gave the above synonymy. The writer regrets that he has been unable to identify any of Stål's species among the South American material. Figures of the head, thorax and tegmen show the chief characteristics of the genus. The vertex is distinctly divided into two parts by a transverse carina which is straight or curved. In *discrepans*, which is only provisionally placed within the genus, the transverse carina forms two arcs and the base of the lateral carinae of the frons is swollen. The hind tibiae are generally unarmed, but in some species there are two small spines. The ovipositor is complete, well developed, curved, the pygofer longer than wide, with a longitudinal depression down the middle. The body is considerably flattened laterally and the tegmina steeply tectiform.

The male genitalia are of the normal Cixiid type. The pygofer is compressed laterally, the lateral margins at or near the anal angle are often produced, the medio-ventral process is always present. The anal segment is large, longer than broad, the ventral surface more or less concave, with the ventral margin beyond anus produced, sometimes asymmetrical and sometimes curved ventrad. The genital styles are generally long and narrow, in transverse section more or less angular, narrow at base and generally broadest at or near apex. The aedeagus is large; the periandrium well developed, tubular or subtubular, well chitinised except at the apex; the base is continued dorsally as a quadrate plate towards the anal segment, in some species there is a small membraneous area in the middle of this plate, in other species this area is larger so that the chitinisation forms a frame. The penis is large, the outer wall often fairly well chitinised, the inner wall complex, folded up when at rest, its surface bearing small chitinous spines, and part of its surface is chitinised; it is highly probable that during copulation a portion of this inner surface is evaginated. Both the periandrium and penis often bear spines of different sizes. A strongly chitinised tube (the apodeme of acnis) runs through the periandrium; distally it continues into the inner wall of the penis, basally it forms the spermatic chamber; the ventral wall of this chamber is formed by the broadening of the wall of the apodeme of penis, the sides and dorsal wall by a thin, transparent, but strong membrane, the continuation of the dorsal and lateral walls of the apodeme. The basal wall or floor of the chamber is formed by a strongly chitinised structure, the bridge; this is formed of a more or less flat surface which articulates to the distad expanded wall of the apodeme of the penis, and dorsally (or internally) is expanded into a large, concave surface produced into two arms; to this concave surface (apodeme of bridge) large muscles are attached which proceed to the walls of the pygofer and work the aedeagus. The bridge, or floor of the chamber, is pierced by a small hole and the ejaculatory duct continues into the body lumen from this point. A strongly chitinised rod (apodeme of genital styles *ap. g. s.*) proceeds from the bridge to between the bases of the genital styles, where it is expanded and forms a close connection with the base of the styles and the median ventral process.

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* Dr. F. Muir died on May 13, 1931, leaving a number of unfinished manuscripts on the Fulgoroidea. These manuscripts, of which the present paper is one, are now the property of the British Museum (Nat. Hist.) and will be published in due course as opportunity arises.—W. E. CHINA.

When working on the homologies of such complex structures as the male genitalia of Fulgorids we must consider the probabilities that things may not always be " what they seem," and in the absence of knowledge of the ontogeny of the above described structures homologies with other Fulgorids, even nearly related ones, are mostly speculation. From observations on a number of species of *Pintalia*, *Andes* and *Oliarus* it appears as if the apodeme of penis is formed by the ejaculatory duct becoming highly chitinised. In Coleoptera such as *Eumolpus surinamensis* we find a highly chitinised ejaculatory duct running well into the lumen of the abdomen. The *chamber*, bridge and apodeme of bridge appear to be continuations of the apodeme of penis and so are probably of a similar origin. The apodeme of the genital styles can be seen to be attached to the bridge and does not appear to be a development from it. It is possible that it arises from the small chitinised area between the base of the genital styles, a sclerite well developed in many Homoptera (v. o. JASSIDAE) and called the *connective*. In *Eurymela* (a primitive type of Jassid) the connective is a small, quadrate plate with a short, broad, thin flange projecting from the middle into the lumen of the pygofer and could very well represent the early stage of the apodeme of the genital style as found in *Pintalia* and many other Fulgorids. When we know more about the ontogeny of these structures in the different families, or groups of families, of Fulgorids we shall be more certain of the homologies, and so have a better understanding of the relationship of the groups and families.

Pintalia fuscipennis sp. n., fig. 1.

Male: length 4·7 mm.; tegmen 5 mm. Width of vertex between basal angles, twice the length in middle and slightly wider than apex (1·2 to 1), transverse carina nearly straight. Length of frons 1·4 times the width. The periandrium is long, slender, tubular, with three spines, the penis is short and without armature; it comes near to *quadrispinosa.* Brown; legs slightly lighter. Tegmina stramineous or light brown on basal half, the subapical and apical cells fuscous; three small fuscous marks in costal cell, a spot at claval fork, another at *Cu* fork and another at *Sc* + *R* fork, a small dark mark on hind margin at apex of clavus; tips of apical veins lighter than membrane. Wings fuscous with dark veins.

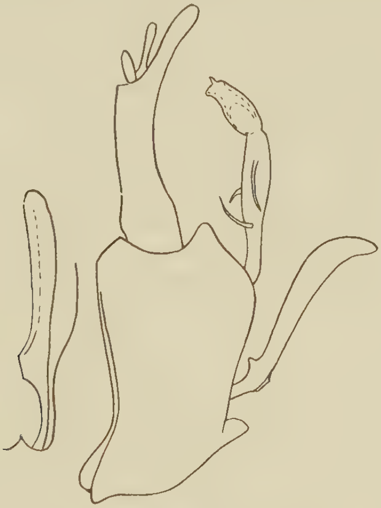


Fig. 1.

Described from one male from Brazil: Jabaty, May 1924 (*F. X. Williams*). Type No. 1246, in collection of Hawaiian Sugar Planters' Assoc. Experiment Station, Honolulu.

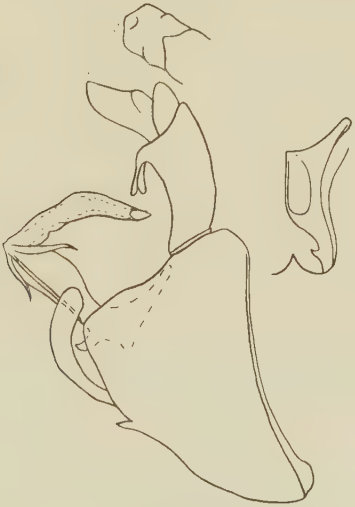


Fig. 2.

Pintalia propria sp. n., fig. 2.

Male: length 3·7 mm.; tegmen 5·3 mm. Width of vertex between basal angles 2·5 times the length in middle and twice the width at apex, the lateral margins from apex to transverse carina parallel, then strongly diverging posteriorly, transverse carina very widely angular, or nearly straight. Length of frons 1·4 times the width, only slightly excavate. The aedeagus has a pair of large spines, one on each side of the base of the penis, and two at apex of periandrium, a long, slender spine and a shorter spine; there is also a fairly large projection on the ventral aspect of the periandrium near base, and a smaller one a little to the right of it. The anal segment is very distinctive, there being a pair of projections from the lateral corners of the apex, and the anal style is large, broad, concave on ventral and convex on dorsal surface.

Dark stramineous; tegmina hyaline, slightly opaque; veins brown; cross-veins and apical cross-veins fuscous, extending slightly into membrane; four small, fuscous spots in costal cell; three small, fuscous marks in basal half, one on *R* and *M*, one slightly beyond *C* fork and one at apex of claval fork; a fuscous spot at the apex of each apical cell, four slightly basad of these and four small spots in subapical cells. Wings hyaline, slightly fuscous with darker veins.

Described from one male from Brazil: Rezende, March 1924 (*F. X. Williams*). Type No. 1245, in collection of H.S.P.A. Exp. Sta., Honolulu.

Pintalia huigrensis sp. n., fig. 3.

Male: length 3·5 mm.; tegmen 6·3 mm. Width of vertex between basal angles 2·4 times the length in middle and 1·6 times the width at apex, transverse carina straight; length of frons 1·4 times the width, lateral carinae large, frons considerably concave.

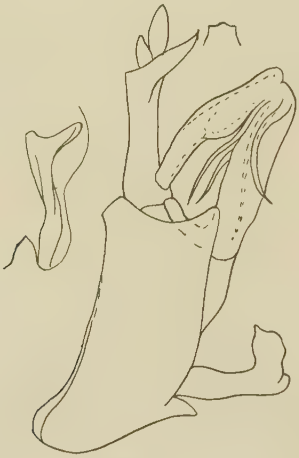


Fig. 3.

Brown, carinae of head and thorax lighter, darkest on lateral portion of mesonotum. Tegmina clear hyaline, veins in apical half fuscous, transverse and apical transverse veins fuscous or brown, veins in basal half lighter with a few darker marks, three minute fuscous marks in apical half of clavus. Wings clear hyaline with brown veins. Male genitalia figured.

Described from one male from Ecuador: Huigra, May 31, 1923 (*F. X. Williams*). Type No. 1244, in collection of H.S.P.A. Exp. Sta., Honolulu.

Pintalia furcata sp. n., fig. 4.

Male: length 3·8 mm.; tegmen 6·5 mm. Width of vertex between basal angles 3 times the length in middle and 1·8 the width at apex; transverse carina nearly straight, slightly anterior to middle on median line. Length of frons 1·7 times the width, widest on apical half, lateral margins slightly arcuate, apex and base subequal in width. Brown, darkest over mesothorax; hind legs lighter than middle and front legs. Tegmina light brown, with darker fuscous over apical portion, with lighter semi-hyaline marks; these semi-hyaline, light marks are :—two small ones in clavus, over *M* and *Cu* basal cells, over *R* fork, through four *R* and *M* apical cells, over *M* 3–4 fork, and a small one on hind margin slightly apical of apex of clavus. Wings slightly fuscous with darker veins. The periandrium has three spines near its apex, two small, curved spines and one larger, fuscate spine; there is a small spine at apex of penis.

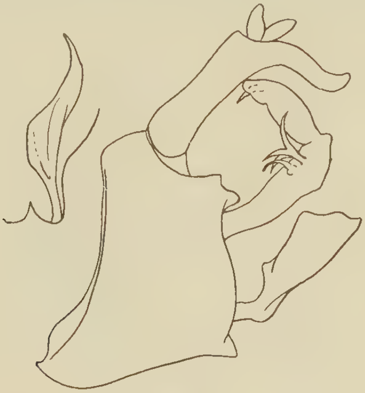


Fig. 4.

Described from one male specimen from Ecuador: Mera, January 26, 1923 (*F. X. Williams*). Type No. 1241, in collection of H.S.P.A. Exp. Sta., Honolulu.

Pintalia distincta sp. n.

Female: length 4·6 mm.; tegmen 5 mm. Width of vertex between basal angles 2·7 times the length in middle and 1·4 times the width at apex; the basal emargination subangular in middle and slightly sinuous. Length of frons 1·4 times the width, base and apex subequal in width, sides slightly arcuate. Middle of frons and clypeus, sides of clypeus and genae behind antennae and the vertex black or fuscous brown, rest of the head light brown; pronotum dark in middle and along anterior margin behind eyes, the rest light; mesonotum light brown, fuscous along margin of posterior angle; abdominal sternites yellow, tergites and genitalia dark brown; legs light brown, front and middle tibiae and tarsi darker brown. Tegmina hyaline, clear, veins brown excepting the claval suture which is yellowish, apical and subapical veins lighter than the basal portions, infuscate in the membrane over the apical veins making a dark line across tegmen, a narrow fuscous line through middle of apical cells. Wings hyaline with brown veins, slightly fuscous along apical margin.

Described from two females from Ecuador: Tena, February 25, 1923 (*F. X. Williams*). Type No. 1239, in collection of the H.S.P.A. Exp. Sta., Honolulu; paratype in Brit. Mus. (Nat. Hist.). The colouration of this species is so distinct that I do not hesitate to describe it from females only.

Pintalia longispinis sp. n., fig. 5.

Male: length 3·4 mm.; tegmen 4·9 mm. Width of vertex between basal angles 3 times the length in middle 1·5 times the width at apex; length of frons in middle 1·4 times the width, sides arcuate from base to apex, apex slightly wider than base; the median carina forms a small but distinct fork at base. Brown, lighter over carinae of head and middle of pronotum; tegmen light sordid brown, opaque, three faint spots, one at claval fork, another at *Cu f*, and the other near *Sc + R f*; a dark mark at apex of clavus, apical margin fuscous extending into half the apical cells, costa dark brown, veins light brown, darker over cross-veins and apical cross-veins; wings light fuscous; opaque with a sordid

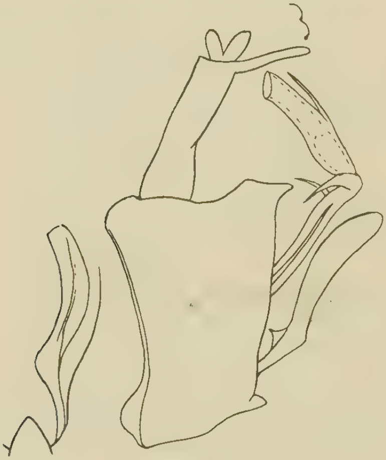


FIG. 5.

white waxy secretion. The genitalia very distinct, a long, slender spine arises from the left side at base and lies alongside the periandrium, two spines arise from the apex of periandrium, one on each side, and two smaller spines arise slightly before the apex.

Female: length 3·4 mm.; tegmen 5 mm. Darker in colour than the male with the spots on the basal half of the tegmen more distinct, the apical cells mostly fuscous with an irregular lighter mark through the middle.

Described from four males and three females from BRAZIL: Belem, Para, May, June 1924 (*F. X. Williams*). Type No. 1232, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

In colour of tegmina this comes next to *blairmontensis*, but it is slightly darker, especially in the female.

Pintalia quadrispinosa sp. n., fig. 6.

Male: length 3·4 mm.; tegmen 5 mm. Width of vertex between basal angles 2·3 times the length in middle and 1·9 times the width at apex, the apex is slightly concave. Length of frons 1·6 times the width, base slightly wider than apex, sides very slightly arcuate on apical two-thirds. Brown; darker over clypeus, middle of frons and the mesonotum, abdomen dark brown, front and middle legs darker than hind legs. Tegmina light sordid brown, lightly opaque with waxy secretion, a dark brown or black mark in middle of costal cell, another in middle of the stem, one at *Cu f* and a fourth at claval fork; fuscous over cross and apical cross-veins, a dark mark on commissure at apex of clavus, apical portions of apical cells slightly fuscous, a faint fuscous mark through middle of apical cells. Wings slightly fuscous with darker veins. The penis is simple and fairly small, the periandrium has four spines, three on the left side, one of them near base, one near middle and one near apex, the spine on right side near apex.

Described from one male from BRAZIL : Arapary, May 1924 (*F. X. Williams*). Type No. 1238, in collection of H.S.P.A. Exp. Sta., Honolulu. This species is nearest to *longispinus*, but differs in the structure of the aedeagus and in colour, the colouration of *obscurata* is close to it, but the spots across the basal half of tegmen are broken circles and not solid.

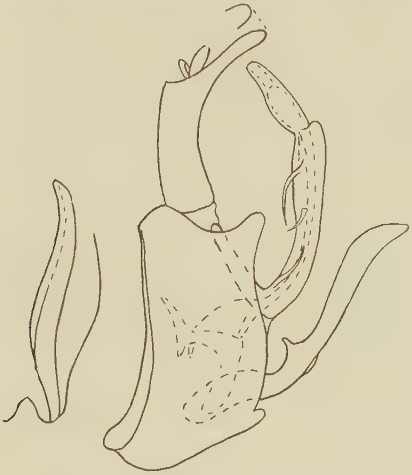


FIG. 6.

Pintalia fuscomarginata sp. n., fig. 7.

Male : length 3·4 mm. ; tegmen 5·6 mm. Width of vertex between basal angles 2·7 times the length and 1·6 times the width at apex. Length of frons in middle 1·6 times the width, apex a little wider than base. The apex of anal segment asymmetrical, the left side rounded and produced considerably ; the penis is produced into a strong, short, curved spine. Stramineous or light brown, slightly darker over frons and mesonotum, abdomen darker brown. Tegmina stramineous, fuscous on apical portion of costal cell, the stigma and along apical margin, the infuscation widest over *Cu* apical veins ; a dark

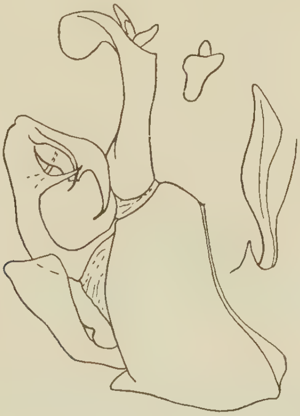


FIG. 7.

mark at apex of clavus, extending along *Cu* to apical infuscation, a faint fuscous line from apex of apical *Rs* to *M*4 over middle of apical cells, slightly infuscate over apical cross-veins, veins same colour as membrane. Wings slightly stramineous with light brown veins.

Female similar to male in build but somewhat darker in colour, the veins of tegmina darker.

Described from three males and two females from ECUADOR : Tena, March, February 1923 (*F. X. Williams*), and one male and one female from Felton's, near Tena, April 1923 (*F. X. Williams*). Type No. 1237, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia obscurata sp. n., fig. 8.

Male: length 4·4 mm.; tegmen 6 mm. Width of vertex between basal angles 2·5 times the length in middle and 1·3 times the width at apex, the vertex therefore short and broad; length of frons 1·4 times the width, base and apex subequal in width, slightly widest on apical half, sides slightly arcuate. There is a faint medio-longitudinal line dividing the apical portion of the vertex (fossette) into two areas (areolets). Genitalia figured; periandrium fairly simple with three spines, the penis produced into a strong, curved spine at apex and has a spine on each side arising on basal half. Brown; dark over mesonotum and abdomen. Tegmina hyaline with brown veins, a slight, irregular, brownish mark from middle of costa to fork of claval veins forming three broken, small circles; slightly fuscous over cross-veins and apical cross-veins, two irregular, narrow, fuscous lines, cross apical cells from *M*3 to *R*, very slightly fuscous over *Cu* beyond apex of clavus, apical margin darker fuscous extending a little into apical cells between apical veins. Wings hyaline, very slightly fuscous, veins darker.

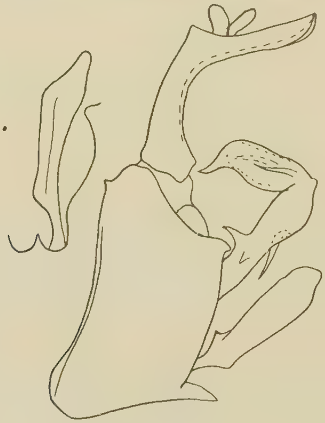


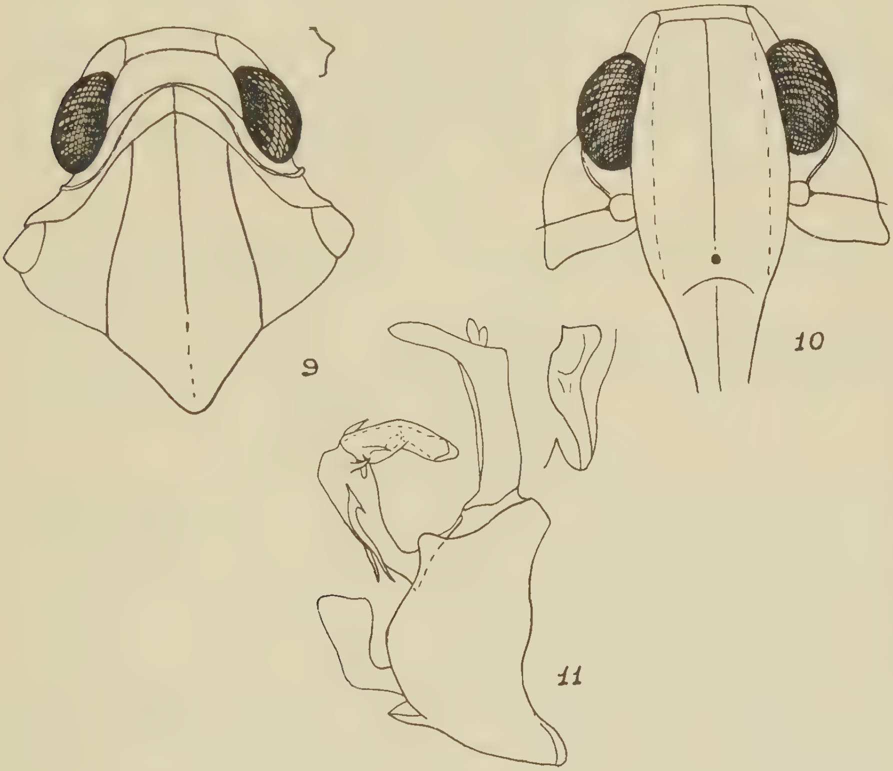
FIG. 8.

Female: length 4·8 mm.; tegmen 6 mm. Similar to male in colour and build.

Described from three males and two females from ECUADOR : Tena, March 1923 (*F. X. Williams*). Type No. 1236, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia lentiginosa sp. n., figs. 9, 10 and 11.

Male: length 3·8 mm.; tegmen 6·4 mm. Width of vertex between basal angles 2·3 times the length of vertex in middle, and 1·5 times the width at apex; sides anterior to transverse carina parallel, posterior to transverse carina they diverge posteriorly considerably, base roundly emarginate, apex truncate. Length of frons 1·6 times the width, sides slightly arcuate, widest near middle, width at apex subequal to width at base, median carina simple, not very distinct. Brown, carinae of head, middle of pronotum, middle of mesonotum and legs lighter. Tegmina hyaline, slightly opaquely white, freckled with slight fuscous, some small, darker marks in costal cell, one in middle of clavus, one at the apex, the freckles nearer together on apical half, veins same colour as membrane or slightly yellowish; granules minute, same colour as veins. Wings hyaline, slightly opaque, veins light yellow. The genitalia are best understood by the figure. Apex of anal segment curved ventrad, rounded.



Figs. 9–11.

Female: length 3·8 mm.; tegmen 7 mm. Similar to the male in structure and colour, but the tegmina slightly more freckled and darker.

Described from eleven males and eight females from Ecuador: Banos, 6000 feet elevation, October 30, 1922 (*F. X. Williams*), and three males and two females from Ecuador: Mt. Tunguragura, 1000 feet elevation, January 4, 1923 (*F. X. Williams*); type is from Banos. There is a slight amount of variation in the number and intensity of the freckles on the tegmina in both sexes. Type No. 1209, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia lentiginosa var. **tunguraguensis** var. n.

There are two specimens, one male and one female, from Ecuador: Mt. Tunguragura, 9000 feet elevation, January 4, 1923 (*F. X. Williams*), which differ from the typical specimen in having the spots in the middle running together forming a dark mark from base, over *R* and *M* to apex. The male genitalia are practically typical. Type No. 1235, in collection of H.S.P.A. Exp. Sta., Honolulu; allotype ♀ in Brit. Mus. (Nat. Hist.).

Pintalia infuscata sp. n., fig. 12.

Male: length 3·8 mm.; tegmen 5·8 mm. Width of vertex at base 2·5 times the length in middle and 1·5 times the width at apex; length of frons in middle 1·6 times the width, width at apex 1·4 times the width at base. The apex of the anal segment is asymmetrical, being produced more on the left than on the right; the penis is membraneous and subtubular with a plate arising from its base which is produced into two spines. Brown or fuscous brown; carinae of frons, pronotum and legs lighter. Tegmina fuscous or brownish fuscous with lighter more hyaline spots, these latter being more numerous on basal half and appearing more like dark spots on the light fuscous background. Wings fuscous with brown veins.

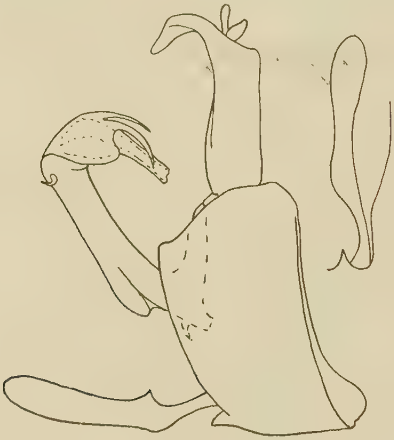


Fig. 12.

Female: length 4·9 mm.; tegmen 7 mm. Similar in build and colour to the male but slightly darker.

Described from one male and one female from Brazil: Campinas, March 1924 (*F. X. Williams*). Type No. 1234, in collection of H.S.P.A. Exp. Sta., Honolulu; allotype ♀ in Brit. Mus. (Nat. Hist.).

Pintalia fuscomaculata sp. n., fig. 13.

Male: length 3 mm.; tegmen 4·3 mm. Width of vertex between basal angles twice the length in middle and twice the width at apex, basal emargination somewhat angular. Length of face in middle 1·5 times the width, sides straight on basal third then slightly arcuate; apex 1·7 times the width of base. The conspicuous features of the aedeagus are the two large spines, one at base of penis and the other at middle of periandrium. Dark brown; the vertex, lateral margins of frons, middle of pronotum, and the legs lighter.

Tegmina stramineous or yellowish mottled with dark fuscous or black, the marking heaviest over apical cells where it appears as fuscous with lighter marks, a mark from apex of costal cell to *Mf* where it joins the apical infuscation and also an infuscation at apex of clavus ; wings light fuscous with brown veins.

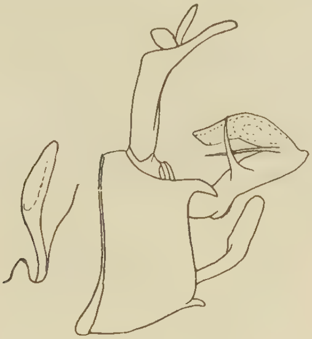


FIG. 13.

Female similar in build and colour to the male.

Described from one male and one female from BRAZIL : Belem, June 1924 (*F. X. Williams*). Type No. 1233, in collection of H.S.P.A. Exp. Sta., Honolulu ; allotype in Brit. Mus. (Nat. Hist.).

Pintalia blairmontensis sp. n., fig. 14.

Male : length 3 mm. ; tegmen 4·3 mm. Width of vertex between basal angles twice the length in middle and twice the width at apex ; length of frons 1·6 times the width, width at apex 1·8 times the width at base. Brown ; lighter over carinae of head, legs and the genitalia. Tegmina opaquely white with waxy secretion with light brown spots, three in clavus, the largest at fork, two in costal cell with four crossing from $Sc + R\ f$ to $Cu\ f$, a darker mark at apex of clavus with a series of eleven small fuscous spots along apical margin between apical veins, veins light brown or stramineous, darker over cross-veins and apical cross-veins, a faint mark in the middle of *M* 1, 1*a*, and 2 cells and near apex of *R* cells ; wings hyaline, slightly fuscous, opaquely white with waxy secretion, veins brown. Apex of anal segment rounded ; the penis very small.

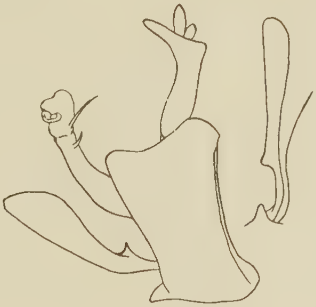


FIG. 14.

Female similar to male but slightly darker in colour.

Described from four males and one female from BRIT. GUIANA: Blairmont, October, November 1923 (*F. X. Williams*). Type No. 1231, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia brunnivenosa sp. n., fig. 15.

Male: length 3·6 mm.; tegmen 5·6 mm. Width of vertex between basal angles 2·3 times the length in middle and 1·5 times the width at apex; length of frons 1·6 times the width, apex slightly broader than base. Light brown; darker between carinae of head, over middle of mesonotum and along the posterior-lateral margin of pronotum.

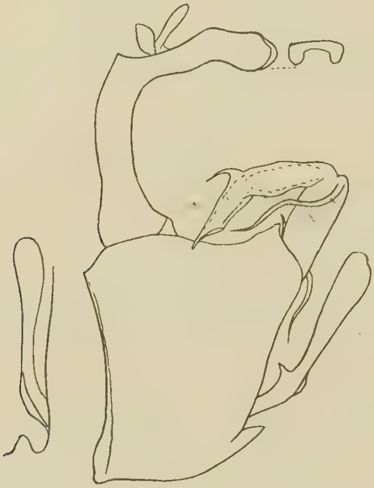


FIG. 15.

Tegmina opaquely white or slightly yellowish with dark brown veins, dark brown along commissure, continued slightly fuscous round apical margin to stigma; wings slightly yellowish fuscous, opaque with a slight waxy secretion, veins brown. Genitalia figured; on the right side of penis near base there is a small, curved spine.

Female considerably darker in colour than the male.

Described from one male and one female from ECUADOR: Tena, February, March 1923 (*F. X. Williams*), and one male and one female from ECUADOR: Mera, February 1923 (*F. X. Williams*). Type locality Tena. Type No. 1230, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia delicata (Fowler).

Metabrixia delicata Fowler, 1904, Biol. cent. Amer. Homoptera, **1**: 86, pl. ix, figs. 23, 23*a*.

There are three female specimens from ECUADOR: Tena, March, April 1923, which agree with the description and must stand under this name until males are procured.

Pintalia bicaudata sp. n., fig. 16.

Male: length 3·8 mm.; tegmen 5·2 mm. Width of vertex between basal angles 2 times the length in middle, and 1·2 the width at apex; sides subangular or arcuate, narrowest at middle; length of frons 1·5 times the width, sides slightly arcuate on apical half where it is widest, lateral carinae deep, making frons excavate; median ocellus distinct at apex of frons. Claval fork distad of middle of clavus, on level with *Cu f*, *Sc* + *R* fork more basad, *M f* level with apex of clavus. Genitalia figured; the apex of anal segment bifurcated. Brown, darker in middle of frons and irregularly extending towards lateral margins; mesonotum lighter between carinae than on the sides. Basal half of tegmen dirty white irregularly spotted with brown, the granules numerous and brown, an irregular brown mark from apex of clavus towards costa irregularly wedge shape; from the base of stigma there is an irregular dark mark to *Mf* and over *Cu* to apex and from *Mf* to apical *Rs* with many irregular dots between leaving a more or less triangular lighter patch with its base along margin from base of stigma to apical *Rs* and its apex reaching to *M* 1 + 2, fork; granules brown bearing light brown macrotrichia. Wings fuscous, lightest across middle, veins fuscous, darkest over apical half.

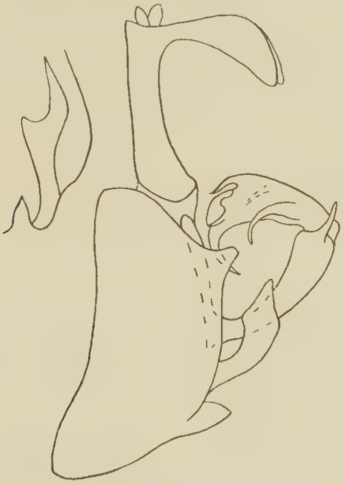


Fig. 16.

Female; length 4·4 mm.; tegmen 6·4 mm. In structure and colour similar to the male but much darker and the colour pattern on tegmen better defined. Anal segment small, longer than broad, subparallel sided, anus at apex; pygofer small, longer than wide; ovipositor longer than pygofer, curved.

Described from nine males and six females from Ecuador: Tena, February, March, and April 1923 (*F. X. Williams*). Type No. 1211, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia obtorta sp. n., fig. 17.

Male: length 3·3 mm.; tegmen 5 mm. Width of vertex between basal angles a little more than twice the length in middle and a little less than twice the width at apex, the transverse carina slightly angular in middle. Length of frons in middle 1·5 times the width, apex slightly wider than base. The genitalia are very distinct and can be best understood by the figures. Brown, lighter over middle of mesonotum, pronotum, vertex and carinae of frons; abdomen dark. Tegmina on basal half dirty white speckled over with fuscous brown, the apical half dark fuscous with lighter areas over *Cu*, a small light spot over apical *R* cells, a small yellowish dot at the apex of each apical vein. Wings fuscous with dark veins.

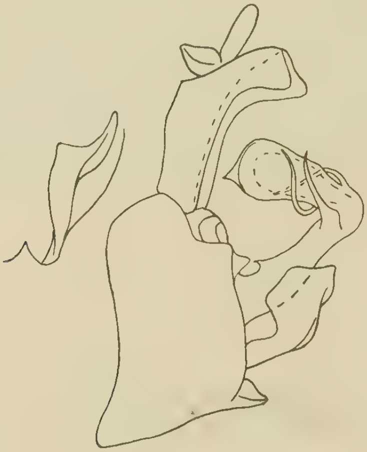


Fig. 17.

Described from one male from Ecuador: Bucay, October 7, 1922 (*F. X. Williams*). Type No. 1212, in collection of H.S.P.A. Exp. Sta., Honolulu.

Pintalia angustinotata sp. n., fig. 18.

Male: length 3·3 mm.; tegmen 5·3 mm. Width of vertex between basal angles about twice the length in middle and nearly twice the width at apex, transverse carina curved; length of frons in middle 1·7 times the width, lateral margins arcuate on apical half, straighter on basal half. Genitalia figured; the anal segment flattened laterally at apex into a subangular plate. Light brown; darker on genae around the eye and ocellus and under the antennae, darker over mesonotum. Tegmina hyaline slightly stramineous with fuscous markings very similar to those of *latinotata* but much narrower, the markings

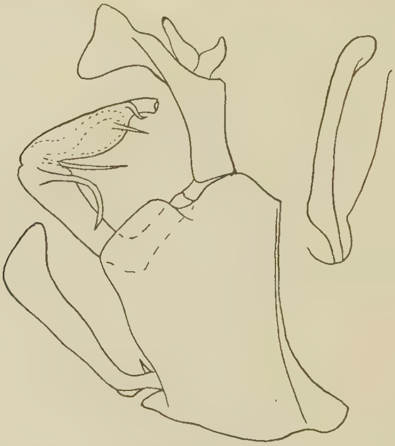


Fig. 18.

in the apical cells being more like a fuscous network than light spots on a fuscous background, it is also somewhat similar to *tumatumariensis* but narrower and with hyaline areas in the apical cells more extensive. Wings light fuscous with dark veins.

Described from two males and one female from Brazil: Belem, and one male and one female from Brazil: Jabaty, Para, May, June 1924 (*F. X. Williams*). Type No. 1229, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia albolineata sp. n., fig. 19.

Male: length 3·2 mm.; tegmen 5 mm. The width between the posterior angles of vertex slightly less than double the length in middle and slightly more than double the width at apex; middle of apex slightly angular where the median frontal carina shows, sides of vertex nearly straight, not greatly carinate. Length of frons 1·4 times the greatest width, apex twice the width of base. Stramineous; vertex, frons and front of clypeus light, sides of clypeus, genae and the lateral carinae of basal half of vertex dark. Tegmina hyaline, fuscous, darker over apical cells and clavus; the commissure from base of tegmen to apex of clavus white, extending to the claval vein, the apical margin light; veins same colour as membrane or slightly darker; wings hyaline, slightly fuscous with dark veins. The genitalia best understood from figure.

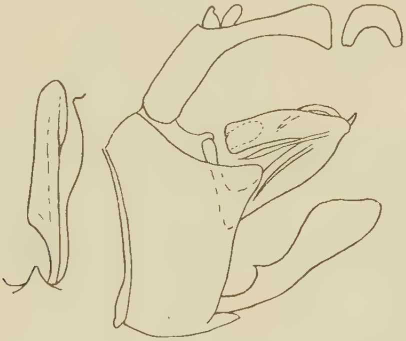


Fig. 19.

Female: length 3·6 mm.; tegmen 5·3 mm. In build and colour similar to male but the tegmina more uniformly darker. Ovipositor complete, long, curved; pygofer small, disc nearly round, much shorter than ovipositor; anal segment small, but slightly longer than wide.

Described from one male and three females from Brit. Guiana: Blairmont, October, November 1923 (*F. X. Williams*). Type No. 1222, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

This is near to *P. delicata* (Fowler), but the tegmina are not so uniformly fuscous and the anal segment appears different.

Pintalia albomarginata sp. n., fig. 20.

Male: length 3·4 mm.; tegmen 4·6 mm. Width of vertex between basal angles slightly more than twice the length in middle and 1·5 times the width at apex; median transverse carina straight, lateral margins nearly straight. The male genitalia best understood from figure; the apex of anal segment slightly asymmetrical, being slightly more produced on left than on right. Head and legs light brown; pronotum, mesonotum and abdomen dark brown; front tibiae and tarsi fuscous. Tegmina dark brown, the commissure and apical margin light. Wings fuscous brown with darker veins.

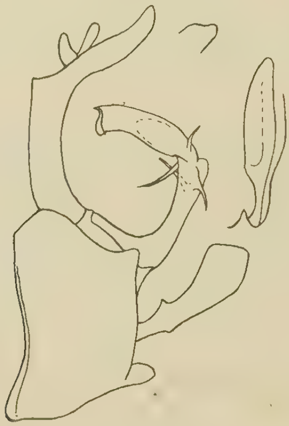


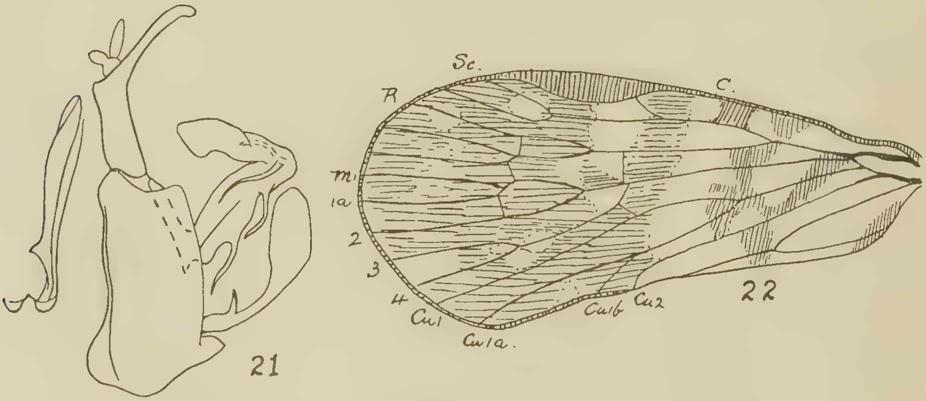
Fig. 20.

Female similar to male in build and colour. Anal segment considerably longer than wide, parallel-sided; ovipositor longer than pygofer.

Described from four males and one female from Brazil: Belem, May, June 1924 (*F. X. Williams*). Type No. 1223, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia tumatumariensis sp. n., figs. 21 and 22.

Male: length 3 mm.; tegmen 4·2 mm. Width of vertex between basal angles twice the length in middle; transverse carina in middle, slightly sinuate; length of frons in middle 1·6 times the width, sides slightly arcuate on apical half, straighter on basal half.



Figs. 21–22.

The anal segment turned slightly ventral at apex and broadly rounded; the periandrium flattened laterally, especially ventrally.

Female similar to male in build and colour. Brown; legs and thoracic pleura lighter.

Tegmina hyaline, sordidly white, with fuscous markings (fig. 22). Wings fuscous with dark veins.

Described from two males and one female from BRIT. GUIANA: Tumatumari, July 19, 1923 (*F. X. Williams*). Type No. 1228, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia latinotata sp. n., fig. 23.

Male: length 3·5 mm.; tegmen 5 mm. Width of vertex between basal angles 2·8 times the length in middle, transverse carina slightly curved about middle. Length of frons in middle 1·5 times the width, lateral margins arcuate on apical half, straighter on basal half. Genitalia figured; apex of anal segment pointed. Dark brown, lighter over lateral portion of pronotum, on legs and abdomen. Tegmina hyaline, whitish or light stramineous heavily mottled with fuscous, the markings somewhat like that of *tumatumariensis* (fig. 22), but the transverse line in middle is more broken and the apical cells have seven or eight irregular but distinct hyaline spots, veins same colour as membrane. Wings fuscous with darker veins.

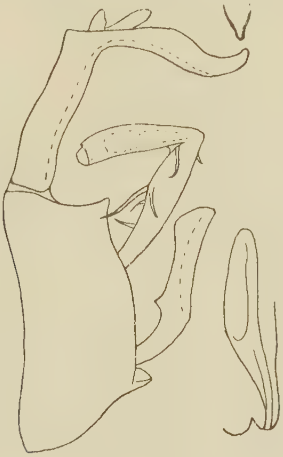


FIG. 23.

Described from one male from BRAZIL: Belem, June 1924 (*F. X. Williams*). Type No. 1227 in collection of H.S.P.A. Exp. Sta., Honolulu.

Pintalia ecuadorensis sp. n., fig. 24.

Male: length 3·7 mm.; tegmen 5·8 mm. Width of vertex between basal angles 2·6 times the length in middle, and 1·5 times the width at apex; length of frons in middle 1·5 times the width, apex and base subequal, sides slightly arcuate. Genitalia figured; apex of anal segment rounded, the basal third of segment tubular, the apical two-thirds concave ventrally. Stramineous or light brown, darker over middle of mesonotum. Tegmina hyaline, slightly stramineous, a few fuscous marks in apical half of costal cell, a small mark across *M* near to *Cu f*, a small mark at fork of *Cu*, another near fork of clavus which is about one-third from apex, a small mark at apex of clavus on commissure, the cross-veins near *Mf* fuscous, the apical cross-veins fuscous. Fuscous over apical portion of apical cells. Wings hyaline, sordidly light stramineous, veins fuscous.

Female: length 3·7 mm.; tegmen 5·7 mm. Similar to male but with a tendency to darker and plainer markings on tegmina.

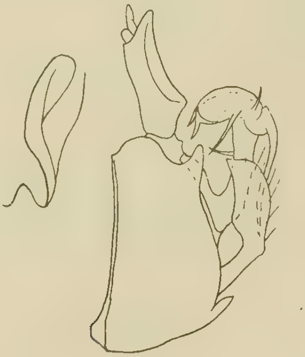


Fig. 24.

Described from one male and one female from Mera, one male and two females from Tena (type locality) and three females from Ecuador: Felton's, Pano River, February, March, April 1923 (*F. X. Williams*). Type No. 1227, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia maculipennis sp. n., fig. 25.

Male: length 3·8 mm.; tegmen 5·3 mm. Width of vertex between basal angles 2·5 times the length in middle; length of frons in middle 1·6 times the width, width at apex slightly greater than at base. The genitalia figured; the apex of anal segment large, bilobed; besides the spines figured on the aedeagus there is one short, stout spine on left side of penis. Brown, slightly darker over pronotum and mesonotum than on head. Tegmina hyaline, sordidly whitish, speckled all over with light brown, most numerously over apical half, the apical cells slightly fuscous, veins light brown, granules minute, same colour as veins. Wings hyaline, slightly fuscous, more so at apex, veins light fuscous.

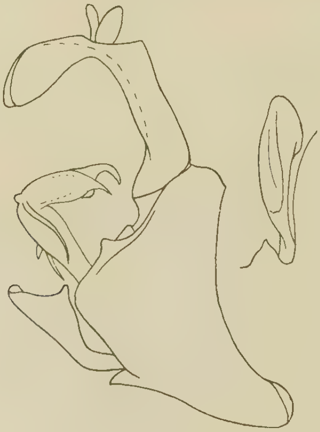


Fig. 25.

Described from one male from Ecuador: Mera, January 26, 1923 (*F. X. Williams*). Type No. 1226, in collection of H.S.P.A. Exp. Sta., Honolulu.

Pintalia pulchella sp. n., fig. 26.

Length 3·3 mm.; tegmen 5·3 mm. Width of vertex between basal angles twice the length in middle and twice the width at apex, base deeply emarginate, the transverse carina much nearer to apex than to base, in dorsal view apex slightly angularly emarginate. Length of frons in middle twice the width, widest on apical half, sides slightly arcuate, apex of frons twice the width of base. *Cu* 1 considerably curved parallel to *M* 3 + 4. Head dark brown or black, lighter over lateral carina of frons and vertex; pronotum and mesonotum brown, whitish on hind lateral corners of pronotum and the tegulae, legs and abdomen yellowish. Tegmina hyaline, slightly opaque and white with brown markings; a light brown mark from base along *Cu* and suture to fork of claval veins where it meets a band of light brown from the middle of costa (where it is dark brown), a dark brown mark at apex of costal cell extending as a lighter band to apex of clavus, at *Mf* it curves over *M* 1 and 2 to apical cells of *R*, the apical portions of apical cells slightly stramineous; veins same colour as membrane, granules minute. Wings hyaline, white, veins slightly stramineous. The genitalia figured; apex of anal segment asymmetrical.

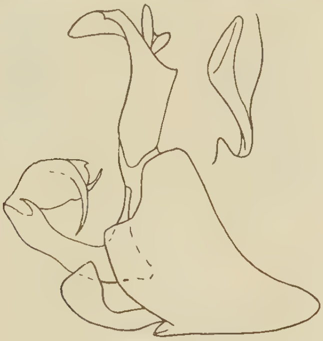


Fig. 26.

Female: length 3·6 mm.; tegmen 5·3 mm. Similar to male but slightly darker in colour, especially the markings on tegmen.

Described from four males and one female from Ecuador: Mera, January, February 1923 (*F. X. Williams*). Type No. 1225, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia ornata sp. n., fig. 27.

Male: length 3·6 mm.; tegmen 5 mm. Width of vertex between basal angles 2·8 times the length in middle and 1·4 times the width at apex. *Cu* 1 strongly bent at cross-veins and to make way for the arched *M* 3 + 4, the hind margin at the apex of suture distinctly, roundedly produced. The genitalia best understood from figure. Head whitish or yellowish, in lateral view a fuscous mark from back of eye over basal portion of carina, continuing on dorsal surface, another across gena in front of eye, a third over ocellus across gena, both showing faintly on frons, sides and apex of clypeus fuscous; pronotum and mesonotum brown, darkest over lateral portions; legs and abdomen yellow, pygofer brown. Tegmina hyaline, slightly opaquely white, with darker and lighter brown markings; extreme base continuing on to clavus light brown or yellowish, an angular band from middle of costa to commissure across the fork of costal veins, darkest on costal cell; a broken mark from apex of clavus to margin at apex of *Rs*, extending brokenly along hind margin to apical *Cu*, a brown mark at apex between *M* 1*a* and 2; a few small brown specks scattered over the white portions; granules few, dark, bearing light brown hairs. Wings hyaline, opaquely white and slightly fuscous, veins brown.

Female: length 3·3 mm.; tegmen 5·3 mm. Similar in colour and build to the male. Pygofer longer than broad; ovipositor longer than the pygofer, the basal portion only resting within a groove, no distinct wax producing area on pygofer but the caudal portion slightly flattened and producing a powder-like wax secretion but no filaments; anal segment small, slightly longer than wide, apex slightly narrower than base, ventral surface excavate.

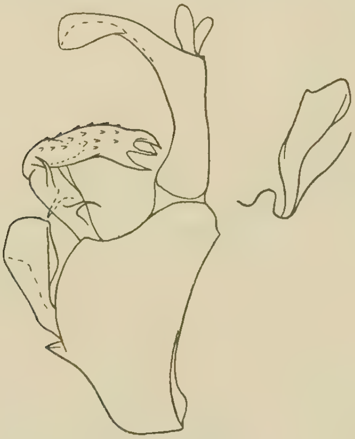


FIG. 27.

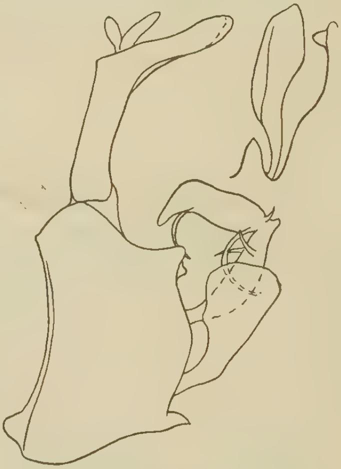


FIG. 28.

Described from four males and six females from BRAZIL: Belem and one male and one female from BRAZIL: Jabaty, Para, May, June 1924 (*F. X. Williams*). Type No. 1224, in collection of H.S.P.A. Exp. Sta., Honolulu; paratypes in Brit. Mus. (Nat. Hist.).

Pintalia altamazonica sp. n., fig. 28.

Male: length 3·4 mm.; tegmen 4·9 mm. Width of vertex between the basal angles 2·5 times the length in middle and 1·6 times the width at apex; transverse carina slightly curved. Length of frons 1·5 times the width, apex slightly wider than base. The lateral carinae at base are distinctly flattened and expanded for a short distance then narrowed. The genitalia figured; the apex of anal segment slightly asymmetrical; the anal angle has a small projection on inner surface; the periandrium has three curved spines at or near apex and one small spine at base of penis, a long, curved spine near apex of penis.

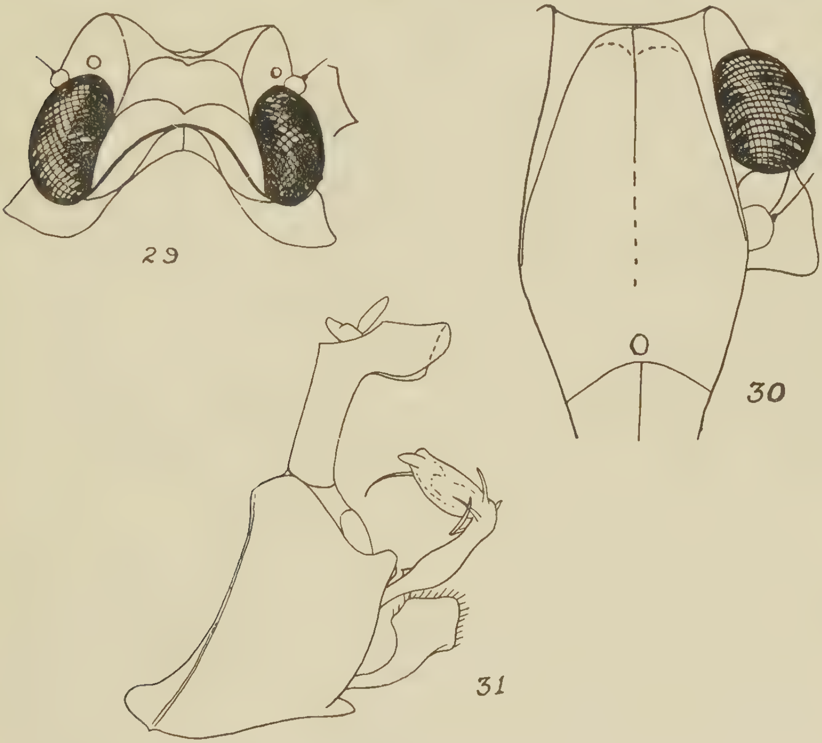
Brown, darkest over lateral portions of pronotum and mesonotum, legs lighter. Tegmina distad of nodal line (apical and subapical cells) fuscous brown, a small hyaline mark in apical portion of *R* and *M* 1 and 1*a* apical cells, small mark in *Sc* apical cell, another near stigma and another yellowish mark on posterior margin at apex of clavus; the basal portion of stigma lighter, slightly fuscous at base and three or four small, obscure fuscous spots in middle. Wings fuscous with darker veins.

Female similar to male; in the tegmina the hyaline spots in apical portion are yellower and in the basal portion the dark, fuscous marks are more distinct.

Described from one male from Ecuador: Tena (type) and one female from Ecuador: Mera, March and April 1923 (*F. X. Williams*). Type No. 1242, in collection of H.S.P.A. Exp. Sta., Honolulu; allotype in Brit. Mus. (Nat. Hist.).

Pintalia (?) discrepans sp. n., figs. 29, 30 and 31.

In size and colour this is similar to *P. altamazonica* in both sexes. The male genitalia are very similar, the apex of the anal segment is shorter and, in lateral view, broader, but it is asymmetrical; the genital styles are slightly more angular in outline and the spines on aedeagus slightly different. But in the generic characters of the head there is a great difference; the lateral carinae of the frons are very wide and flattened at the base and gradually decrease to about one-third from apex, a character found only slightly in *altamazonica*. The transverse carina of the vertex forms two areas, and the bases of the frontal carinae are visible.



Figs. 29–31.

This species is of great interest for here we see generic characters that have departed considerably from the normal while the specific characters have altered but slightly.

Described from one male and one female from Ecuador: Tena, February 19, 1923 (*F. X. Williams*). Type No. 1243, in collection of H.S.P.A. Exp. Sta., Honolulu; allotype in Brit. Mus. (Nat. Hist.).

Besides the above described species there are, in Dr. Williams' collection, ten female specimens which the writer cannot associate with any described males but does not care to describe from single females.

FURTHER EXPERIMENTS ON COLORATION AND RELATIVE ACCEPTABILITY OF INSECTS TO BIRDS

By FRANK MORTON JONES, Sc.D.

[Read 3rd October, 1934.]

WITH PLATES XVI AND XVII.

IN the 1932 *Transactions of the Entomological Society of London*, **80** : 345–385, pls. XVIII–XXVIII, under the title, "Insect coloration and the relative acceptability of insects to birds," I recorded the results of a long series of experiments in feeding freshly-killed insects to wild birds. These experiments involved the use of about 5000 insects of 200 species; and the paper gave numerical expression to the relative acceptability of these insects as evidenced by the order of their acceptance (or eventual refusal) by birds of eight species, and traced correlations between types of insect coloration and their relative acceptability.

Similar experiments have been continued on the island of Martha's Vineyard, Massachusetts, through August and early September, 1932, and from late June to early September, 1933; and another series of experiments involving different sets of bird and insect species was conducted through March and early April, 1933, at Royal Palm State Park in extreme southern Florida.

Experiments in southern Florida.

The Florida experiments were similar to those already recorded, with these exceptions :—

(*a*) The feeding-tray was placed upon the ground with a mat of burlap surrounding it, making it more easily possible to recover insects accidentally swept from the tray by the visiting birds.

(*b*) The bird-visitors were all adult winter-resident birds, not engaged in feeding young.

(*c*) To these birds the primary attraction to the feeding-area was often the grains and seeds provided rather than the insects; but all species of the recorded bird-visitors ate insects from the tray, as well as grains and seeds.

(*d*) One of these bird species (Maynard's Redwing), instead of visiting the tray singly or in family groups, sometimes crowded the tray in flocks of twenty or more, so that the number of visits recorded for that species is only an approximation serving in some degree to indicate their frequency in comparison with the visits of other birds.

In twelve experiments, six species of birds came to the feeding-tray. Their names, the number of experiments in which each species participated, and the recorded number of visits for each species are tabulated on p. 444.

Most of these birds are not predominantly insectivorous for the entire year, though each of them for at least some portion of the year takes more animal food (chiefly insects) than vegetable.

Bird species.	Number of experiments.	Recorded visits.
1. Maynard's Redwing (ICTERIDAE) (*Agelaius phoeniceus floridanus* Mayn.)	11	791
2. Florida Cardinal (FRINGILLIDAE) (*Cardinalis cardinalis floridanus* Ridgw.)	11	396
3. Grackle (ICTERIDAE) (*Quiscalus quiscula quiscula* L.)	7	80
4. Brown Thrasher (MIMIDAE) (*Toxostoma rufum* L.)	9	57
5. Yellow-throated Warbler (MNIOTILTIDAE) (*Dendroica dominica dominica* L.)	2	12
6. Catbird (MIMIDAE) (*Dumetella carolinensis* L.)	1	1
	12	1337

It had been anticipated that in southern Florida it would be possible to subject to test some of the gaudily coloured day-flying Syntomid moths, as well as other tropical insects whose records might have special significance; and these expectations were carried out as fully as an unusual seasonal scarcity of insect life permitted. By industrious daytime collecting and by putting out attractive baits on every suitable evening, between four and five hundred insects (of the four Orders, Lepidoptera, Orthoptera, Coleoptera, Hemiptera) were secured and used in experimental feedings. Of many species, however, only a few could be procured—sometimes sufficient for use in only a single experiment. Based upon the order of its acceptance, acceptability ratings were calculated for each species, as explained fully in an earlier paper (*loc. cit.*, pages 347, 348, 380), and the species have been grouped into tabulations permitting comparisons among those of like character—that is, among the moths, the butterflies, the Orthoptera, and perhaps less significantly among the other orders. In 11 experiments utilising 353 insects, 186 moths belonging to about 30 species were used. Eliminating six of these which were obtained in single examples only (five of the six were eaten), the results are tabulated on p. 445.

The 135 moths listed in the upper section of this table conformed, in general, to the prevailing colours and coloration of their families and genera—that is, they were all of various tones of grey and brown without bold patterns or strong contrasts of colour, and without any clear yellow, red, orange, blue, or metallic markings; and all of them were dusk or night-flying insects, seeking concealment by day. In decided contrast to these in coloration and habit were the 45 moths of four species, listed in the lower section of the table. Each of these four species deserves separate mention.

Syntomeida ipomeae Harr. and *Syntomeida epilais* Wlk. (Plate XVI). These two Syntomid moths are day-flying insects of gaudy coloration and wasp-like form. Rather slow and clumsy in flight, they are usually seen visiting flowers or clinging motionless to low herbage. Their wings are black with a strong sheen of metallic green, and are conspicuously spotted with yellowish-white or white. The thorax and abdomen of *ipomeae* are spotted and striped with orange rufous; *epilais* is spotted with silvery white, and the last two visible segments of its metallic blue abdomen are scarlet. The larval food-plants of *epilais* are native species of *Echites* (Apocynaceae) and the introduced and poisonous Oleander.

FEEDING EXPERIMENTS : MOTHS.

	No. of experiments.	Total no. of insects.	Of this species.	Left uneaten.	Acceptability rating.	Bird-species.*
SPHINGIDAE.						
Ampeloeca myron Cram.	2	76	2	0	81·2	1, 2, 3, 4, 5
NOCTUIDAE.						
Feltia sp.	3	107	3	0	100·0	1, 2, 3, 4
Cirphis sp.	3	115	3	0	100·0	1, 2, 3
Perigea sp.	5	132	10	0	92·5	1, 2, 3, 4, 5
Acronycta oblinita A. & S.	6	174	6	0	91·6	1, 2, 3, 4
Prodenia sp.	2	36	2	0	100·0	1, 2, 3, 4
Pelamia sp.	7	209	8	0	100·0	1, 2, 3, 4, 5
Safia amella Gn.	10	340	24	1	89·7	1, 2, 3, 4, 5
Zale sp.	10	314	37	0	95·0	1, 2, 3, 4, 5
Siavana repanda Wlk.	8	285	12	0	83·3	1, 2, 3, 4, 5
Peosina pandrosa Cram.	2	53	3	0	83·3	1, 2, 3, 4
Epidromia delinquens Wlk.	3	135	5	0	100·0	1, 2, 3, 5
Massala obvertens Wlk.	1	36	3	0	87·5	1, 2, 4, 5
Capnodes rufinans Gn.	2	96	3	0	87·5	1, 2, 4, 5
Dull-coloured Noctuids, 5 sp.	5	193	14	0	76·5	1, 2, 3, 4, 5
	11	353	135	1	90·8	
SYNTOMIDAE.						
Syntomeida ipomeae Harr.	7	213	12	10	12·2	1, 2, 3, 4, 5, 6
Syntomeida epilais Wlk.	5	214	8	8	0·0	1, 2, 3, 4, 5
ARCTIIDAE.						
Utetheisa bella L.	5	163	14	13	3·5	1, 2, 3, 4, 5, 6
NOCTUIDAE.						
Xanthopastis timais Cram.	5	153	11	8	9·8	1, 2, 3, 4, 5, 6
	11	353	45	39	6·7	

* As identified by these numerals on the list, page 444.

Utetheisa bella L. (Plate XVI). This moth is not exclusively day-flying in habit, though it visits flowers by day and flushes readily from low herbage. Its body is snowy white, the head and thorax spotted with black. The fore-wings are chiefly yellow to orange buff, in varieties deepening even to coral red, and crossed by irregular white bands enclosing black spots between the veins. The hind-wings, hidden when at rest, are bright pink margined with black. The unripe seed-pods of *Crotalaria* (Leguminosae) are the preferred food of the larvae, and at Royal Palm State Park the plant associate was *Crotalaria pumila* Ort.

Xanthopastis timais Cram. (Plate XVI). This sluggish Noctuid moth habitually rests by day on the smooth trunks of Royal Palms, the trunks and branches of *Ficus*, and in other smooth-surfaced and exposed situations, from which it may readily be plucked between the fingers. When thus disturbed, it makes little effort to escape, but uncoils and extends its short yellow tongue, conspicuous in the dark vestiture of the head, and often emits a drop of fluid from the end of the abdomen, which it holds rigidly in a curved position. The thorax of this moth is exceptionally shaggy in appearance and its long black vestiture is shortly tipped with white. The fore-wings are corinthian pink, black, and cadmium yellow in an intricate pattern; the hind-wings, hidden in resting posture, are smoky. The conspicuously banded larvae feed in colonies on *Crinum* and *Pancratium* (Amaryllidaceae).

As shown by the table, these four insects, conspicuous by gaudy coloration and daytime habit, were each used in not less than five experiments in competition with a larger number of dull-coloured moths of twenty species. Only one of the 135 dull-coloured moths (·74 of 1 per cent.) was left upon the tray uneaten; of the 45 gaudily-coloured moths, 39 (or 86⅔ per cent.) were left upon the tray at the conclusion of the same experiments participated in by six species of birds.

The 135 dull-coloured moths earned an average acceptability rating of 90·8, with no species rating less than 76; the 45 gaudily-coloured moths earned an average rating of 6·7, with 12·2 the highest for any one of the four species. These differences in acceptances and refusals are inexplicable except as expressions of bird-preferences in the selection of food.

In southern Florida at the time of experiment, butterflies were not readily procurable in numbers and variety, and consequently these insects were used in only five feeding experiments in competitions totalling 168 insects. These included only 37 butterflies of 14 species, and under these circumstances calculated acceptability ratings for each species could possess little significance beyond that made apparent by the following tabulation :—

FEEDING EXPERIMENTS : BUTTERFLIES.

	No. of experiments.	Total no. of insects.	Of this species.	Taken from tray.	Left on tray.	Bird-species.
DANAIDAE.						
Danaus berenice Cram.	2	85	11	0	11	1, 2, 3, 4, 5, 6
SATYRIDAE.						
Neonympha phocion Fab.	1	23	1	1	0	1, 2, 3, 4
HELICONIINAE.						
Heliconius charithonia L.	2	84	3	1	2	1, 2, 3, 4, 5, 6
Dione vanillae L.	2	85	2	0	2	2, 3, 4, 5, 6
NYMPHALINAE.						
Phyciodes phaon Edw.	1	40	1	1	0	2, 3, 4
Phyciodes tharos Dru.	2	63	2	1	1	1, 2, 3, 4
Vanessa atalanta L.	1	39	1	1	0	1, 2, 3
Junonia coenia Hbn.	1	40	2	1	1	2, 3, 4
HESPERIIDAE.						
Pyrgus syrichtus Fab.	1	40	1	1	0	2, 3, 4
Ephyriades zephodes Hbn.	2	62	2	2	0	1, 2, 3, 4
Thanaos horatius S. & B.	1	23	3	3	0	1, 2, 3, 4
Hylephila phylaeus Dru.	1	40	3	3	0	2, 3, 4
Catia otho A. & S.	1	23	1	1	0	1, 2, 3, 4
Lerodea maculata Edw.	4	145	4	4	0	1, 2, 3, 4, 5, 6
	5	168	37	20	17	

The table shows that all the HESPERIIDAE, 14 insects of 6 species, were eaten, though in average size they were exceeded by the remaining butterflies. Of *Danaus* and *Dione* (13 insects), none was eaten. Of *Heliconius*, one disappeared from the tray; but a note on the record-sheet of that experiment states that "*Heliconius* picked from tray by Redwing, carried to margin of mat, banged a few times, piece broken from hind-wing, insect then dropped and afterward disregarded."

Coleoptera and Hemiptera were not obtained in numbers and variety adequate for satisfactory comparative tests, nor were any of them accepted as freely as were the dull-coloured moths of the same experiments. The showy yellow and black Lycid beetle, *Calopteron reticulatum* Fabr.; the orange and black Lygaeid bug, *Oncopeltus sexmaculatus* Stål., which feeds in conspicuous clustered colonies on an Asclepiad vine; a red and black Capsid bug of similar habit on *Cardiospermum*—these three were among those left on the tray uneaten. Thus far in accord with previous results, the absence from the experiments of a sufficient series of fairly comparable insects of demonstrated acceptability detracts from the significance of their refusal.

Results with Orthoptera seemed more surely significant. In the literature of economic ornithology, "grasshoppers" have been recorded among the food of all six species of birds which visited the tray, and in the experiments these insects were accepted more freely than were the beetles and bugs I was able to procure, though less promptly than were the dull-coloured moths. In the Orthoptera, generic identifications have been made for me, from a preserved duplicate series, by Mr. J. A. G. Rehn. All the Orthoptera used in experiment were of moderate size, and with a single exception all the species were accepted by the birds. Their use in seven experiments may be tabulated thus:—

FEEDING EXPERIMENTS: ORTHOPTERA.

	No. of experiments.	Total no. of insects.	Of this species.	Left uneaten.	Acceptability rating.	Bird-species.
ACRIDIIDAE.						
Amblytropidea sp.	3	90	4	0	49·5	1, 2, 3, 4, 5
Orphulella sp.	3	120	12	2	48·6	1, 2, 3, 4, 5
Radinotatum sp.	2	63	7	0	55·0	1, 2, 3, 4
Schistocerca sp.	2	59	5	2	50·0	1, 2, 3, 4
CONOCEPHALINAE.						
Homorocoryphus sp.	1	40	1	0	100·0	2, 3, 4
GRYLLIDAE.						
Tafalisca sp.	1	45	1	0	50·0	1, 2, 3, 4, 5
	7	248	30	4	52·2	
ACRIDIIDAE						
Romalea microptera Beauv.	7	248	28	25	6·0	1, 2, 3, 4, 5

The 30 insects of the upper section of the table were of inconspicuous coloration—grey or brown. Some of them were nymphs of later stadia, others were winged adults. 26 of the 30 were eaten, leaving 4 (or 13⅓ per cent.) on the tray at the termination of the experiments. The 28 insects of the second section belonged to a single species (*Romalea microptera* Beauv., Plate XVII). These insects, shining black conspicuously striped with clear yellow (reddish-yellow in the earliest stadium), were nymphs of the 2nd, 3rd, and 4th (?) stadia, measuring as dry specimens 18 to 30 mm. in length, hence fairly comparable in size with those listed in the upper section of the table. Of *Romalea*, 25 of the 28 (or 89·3 per cent.) were left upon the tray at the conclusion of the same seven experiments. The average acceptability ratings of the insects of the two sections of the table were respectively 52·2 and 6·0.

Not only the coloration of *Romalea*, but its observed habits and the literature give it special interest in connection with these comparative results. On account of its form and its slow and clumsy movements (the winged adults are unable to fly) commonly known as the "Lubber Grasshopper," it was perhaps the first insect species to be designated as unacceptable or inedible to predators; and that character was ascribed to it long before any theories of "warning coloration" had been advanced. In the seventeen-volume collection of original and unpublished watercolours of American (Georgian) insects by John Abbot, preserved in the British Museum (Natural History), this insect is twice illustrated (in Vol. V, page 38; Vol. XVI, page 2; Vol. V bears the date 1792; Vol. XVI, 1804); and a third drawing of it is included in the collection of Abbot watercolours in the possession of the Boston (Massachusetts) Society of Natural History. Each drawing is accompanied by a manuscript note in the handwriting and the quaint language of the artist-naturalist. In substance, the three notes are almost identical, and a quotation from the 1792 drawing, with some punctuation inserted for clarity and a clause added from the 1804 version, is as follows :—

"No. 10. Gryllus. When young the whole brood keeps together . . . dispersing as they grow larger . . . it is very slow and inactive which would render it an easy prey to its Enemy had not nature provided another means for its defense. When touched or molested it emits a brown liquid from its Joints or rings of its body of so stinking and offensive nature, that Fowls and Birds refuse to eat them; called in Savannah, Great or Stinking Grasshopper, very common."

Whether subsequent observers of this insect were influenced by Abbot's (unpublished) notes does not appear, but the language of some of them implies independent observation. Hubbard (1885, *Insects affecting the Orange*, p. 136) says, "Predacious animals cannot be induced to feed upon it, and doubtless its juices have an acrid and disagreeable flavour. Its sluggish habits, taken in connection with its conspicuous coloration, show that it has little need of concealment." Blatchley (1920, *Orthoptera of north-eastern America*, p. 306) says of this insect, "They are very slow and clumsy in movement, crawling feebly over the ground when knocked off the plant to which they were clinging. Their natural enemies are few, they being apparently so nauseating that even chickens reject them as food." Hebard (1925, *Trans. Amer. ent. Soc.*, **51** : 6) accepts the interpretation of their secretions as defensive in character, and says, "This brown fluid is exuded from the thoracic spiracles by contractions of the abdomen, if an individual is seized. It escapes as a bubbly froth, at each contraction of the abdomen making a decided hissing sound."

As I frequently observed this insect in southern Florida, the groups of young locusts fed in assemblages on low herbage and crept to higher and more exposed positions and formed even more crowded groups at night (Plate XVII). Though Shufeldt (1883, *Science*, **2** : 811–814) determined the number of eggs per deposit at 30–35, the number of insects in a group often greatly exceeded those figures, and one such group of which I made a rough count numbered about 140 individuals and included insects of different ages. As Shufeldt states, these conspicuous groups "could be seen at several hundred feet distance." The coherence of the group decreases with the age of its components, until insects of the last nymphal instar, by size then individually conspicuous, are solitary in habit, though several former group-companions are often visible at once.

In coloration and in the habit of night-assemblage, this insect curiously suggests *Heliconius*. Like *Heliconius*, the night response of the sleeping group to alarm is a waving of the antennae and uneasy movements of the feet; and if the source of disturbance is continued and is sufficiently violent, the group disintegrates by sudden dispersal in all directions. Reassemblage is obviously less certain than with *Heliconius*, and in *Romalea* no positive evidence of place-memory was observed, for the group sleeping-place, on succeeding nights, is often many feet removed from its former locations. In their daytime wanderings for food and in their reassemblages, groups are frequently split, and outlying stragglers from main groups are often in evidence. Under these conditions it is impossible to determine by actual count, whether any given group is being depleted by predation; but the demonstrated refusal of this insect by several grasshopper predators and the later seasonal abundance of adults bears out the interpretation of their conspicuousness of coloration and of habit as an asset toward survival rather than an added danger.

Another experiment of a different nature was conducted in southern Florida in 1933. In the feeding experiments it had been apparent that the order of selection was substantially identical in general character, whether the birds came to the tray singly or in excitedly competing groups, and that there was usually a traceable relation between the size and coloration of the insects provided and their relative acceptability to the birds. For possible light upon their ability for prompt recognition of differences not so obviously based on these characters, it seemed worth while to test their behaviour and their expressions of preferences in the presence of other kinds of food. To this end, eight kinds of seeds and grains, some of which had been used as attractants to the tray, were placed separately and in equal measured quantities (25 c.c. of each) in shallow boxes of identical size and shape, and exposed on the tray, evenly spaced, to the visits of the birds. After a suitable interval, all eight boxes were brought in, and the remaining contents of each, with any portion spilled on the tray by the birds, was measured and recorded. Then in a second experiment like quantities of these same food-items *were thoroughly mixed* (Plate XVI) and the mixture exposed upon the tray for a similar period, after which what remained was brought in, carefully sorted for kind, and the remaining volume of each kind measured.

Exact duplication of total or proportionate acceptance of the components was not anticipated, for obviously the bird-visitors through the first test would not be duplicated in numbers or in relative frequency of visits by species in the second test; and though no bird species restricted itself to a single food item (Cardinals were observed to accept 6, Redwings 5, and Grackles 3 kinds of food), yet as species they nevertheless did exhibit unmistakable preferences. In the order of quantities consumed, the eight food items of the two tests are listed below :—

FOOD ITEMS, LISTED IN THE ORDER OF QUANTITIES CONSUMED.

First experiment. Food items separate.	Second experiment. Food items mixed.
Sunflower	Sunflower
Finely cracked corn (maize)	Finely cracked corn (maize)
Hemp	Hemp
Kafir	Yellow millet
Wheat	Kafir
Yellow millet	Buckwheat
Buckwheat	Wheat
Rapeseed	Rapeseed

In both experiments, Cardinals, Redwings, and Grackles were frequent visitors to the tray; and a Brown Thrasher made a few visits in the first experiment. Redwings coming singly were observed to be the species most frequently taking food from the box of yellow millet; in the second experiment a whole flock of Redwings descended on the tray and for a time almost excluded other birds. This probably accounts for the shifting of yellow millet from the 6th place in the first list to the 4th place in the second. The first three and the last items in both lists are identical and occur in the same order.

The plain implication of these two experiments is that bird-preference decides acceptance, whether the food-items are separate or mixed; that choice for acceptance must be based upon promptly recognised visible differences in food-items of the same general character; and that under the conditions of experiment, *food preferences* rather than either *quantity* or *availability* decided the order of acceptance.

FURTHER EXPERIMENTS AT MARTHA'S VINEYARD, MASSACHUSETTS.

A previous paper recorded the results of ninety feeding experiments made on the island of Martha's Vineyard, Massachusetts, involving the use of nearly 5000 insects of 200 species. In 1932 and 1933 and at the same place, forty-three similar experiments utilised over 2000 insects (Lepidoptera and Coleoptera) of 116 species. Naturally this second series of experiments involved many insects (1898 insects of 90 species) duplicating in kind those used in the earlier experiments. Even in the first series, a considerable degree of *predictability of result* had been attained and frequently confirmed by experiment, for many insect species; and though obviously the uncontrollable factors were too numerous for uniformly exact duplication to be anticipated, in the calculated acceptability ratings of insects used in the two series of experiments, yet the grounds for predictability became more secure as experiments multiplied. The extent to which the second series of experiments often did result in close agreement with the first series may be illustrated by the records of the Lepidopterous family SPHINGIDAE. Over a period of four years, in 46 experiments utilising 126 of these insects of inconspicuous coloration in resting attitude, *all* were eaten; and for each of the two-year periods the average acceptability ratings for these insects were respectively 93·3 and 94·4—that is, these ratings were almost identical. In the four years, only one other insect of this family and not included in the above record, was utilised in experiment; and though I have recognised that a single experiment has slight or sometimes no evidential value when considered alone, a possible significance makes it desirable that this one instance should be placed on record; for in direct contrast with all the remaining SPHINGIDAE, *Haemorrhagia thysbe* Fabr., a brightly-coloured insect with partially transparent wings, day-flying and active by habit, was left uneaten upon the tray through an experiment lasting 3¼ hours and in which 37 smaller Lepidopterous insects were taken by the birds; and its condition when examined at the termination of the experiment showed plainly that it had been picked up, mauled in the beak of a visiting bird, and rejected.

It is also necessary to record that with reference to a single species the confidence usually justified in the predictability of the behaviour of the birds toward some types of insect coloration failed of realisation. In the account of earlier experiments, record was made of the use of 19 examples of *Synanthedon sigmoidea* Beut., a black and yellow wasp-like Aegeriid moth, from which it appeared that this insect was no more readily accepted by the birds involved in the experiments than were the true wasps which it is supposed to mimic to its own advantage. Again through the kindness of Mr. George P. Engelhardt, I was able to test another and larger Aegeriid, *Parathrene simulans* Grt., which is perhaps an even closer mimic of some of the black and yellow stinging Hymenoptera. *P. simulans* was available in only five individuals, and these were used in four successive experiments on as many days, in competition with a total of 219 insects. All five of the *simulans* were eaten, and four of them were taken promptly upon display. Aside from all theories of protective mimicry, it is difficult to reconcile the uniform acceptance of this insect with the fact that among the 250 species and 7000 insects used in these four years of experiment, no other species of this type of coloration and degree of conspicuousness gave similar results, when used even to this limited extent. A careful review of the four experiments (those of 16, 18, 20, 21 July, 1933) gives a clue to a possible explanation. Though six bird-species visited the tray in the progress of the experiments, one species (the Blue Jay—CORVIDAE) was the only species present in all four experiments; and in two of the experiments it was determinable that *simulans* was taken by a Blue Jay, the only bird-visitor in the tabulation periods in which this insect disappeared from the tray. Further, on the occasion of the first of these four experiments (16 July) the record shows that six Blue Jays were present on the tray at once, and that among them were young birds feeding themselves and occasionally being fed by their parents. It is at least conceivable that in this first experiment a Blue Jay (perhaps a young bird) took and found acceptable this conspicuous insect, and in the succeeding experiments with short time-intervals intervening, continued to recognise and accept it on the basis of that experience. This would be in accord with the interpretation of *simulans* as a Batesian mimic of *Vespa*. More evidence is desirable.

The extent to which the second series of experiments (1932–1933) did agree with the first series (1930–1931) in close resemblances and in general results, becomes apparent from the following :

I.—Of the 90 species of insects which were represented in both the first and the second series of experiments (3216 of these insects in the first series, 1898 in the second), *not one* of the species classed in the first series as relatively most acceptable (rating 60 to 100) fell to the status of least relative acceptability (rating 0 to 25) in the second series of experiments.

II.—Of those species classed in the first series as least acceptable (rating 0 to 25) and again subjected to test in the second series, only one species rose from the status of least acceptability to that of full acceptability; and that one (*Actias luna* L.) in each series was used in a single example, and for that reason it had already been indicated (*loc. cit.*, 353) as one of several whose nominal ratings possessed no necessary significance.

III.—Changes to or from intermediate ratings (rating 25 to 60) were greatly in the minority in that classification, and their total effect on the status of gaudily coloured insects of low relative acceptability was to transfer the pink and yellow Noctuid, *Rhodophora florida* Gn. (old rating, 31·7) to the lower rating, and the genus *Necrophorus* from low to intermediate rating.

The general results, therefore, of this second series of experiments, including also those of southern Florida, confirm and strengthen the conclusions based upon the first series, and extend their range of application to additional series of insects and of birds. From a total of 145 tabulated experiments covering a period of four years and including both the Massachusetts and Florida records, the bird-species and bird-visits are shown in the following table :—

RECORD OF BIRD-SPECIES AND BIRD-VISITS.

	No. of experiments.	No. of recorded visits.	Total no. of bird-visits.
CORVIDAE.			
Blue Jay (*Cyanocitta cristata* L.)	75	620	620
ICTERIDAE.			
Grackle (*Quiscalus quiscula* L.)	48	370	
Maynard's Red-wing (*Agelaius p. floridanus* Ridgw.)	11	791	
Cowbird (*Molothrus ater* Bodd.)	11	17	1178
FRINGILLIDAE.			
Song Sparrow (*Melospiza melodia* Wils.) . .	91	1007	
Towhee (*Pipilo erythrophthalmus* L.) . . .	116	1194	
Florida Cardinal (*Cardinalis c. floridanus* Ridgw.)	11	396	2597
MIMIDAE.			
Catbird (*Dumetella carolinensis* L.)	29	164	
Brown Thrasher (*Toxostoma rufum* L.) . .	25	125	289
TURDIDAE.			
Robin (American) (*Turdus migratorius* L.) . .	48	265	265
			4949

From this table of experiments and bird-visits; from observation and records of many individual experiments; and from the assembled records of insect species numerously used and of the bird visitors accepting or refusing them, it has become apparent that discrimination on the part of the birds, as conditioned by types of insect coloration, is true alike for all of these bird-species; and that this discrimination is displayed, whether the insects upon the feeding-tray are many and varied, or whether they have been reduced by bird selection to one or a very few of relatively unacceptable species thus left upon the tray through long periods. As with the seeds and grains, therefore, acceptability of insects is determined, not primarily by numbers and availability, but by bird preferences.

After this long series of experiments with their cumulative evidence of the actuality of the influence of the coloration of insects on their relative acceptability to these birds, a further question arises in logical sequence: Does the behaviour of these bird-species furnish any measure of the influence of avian predators in general, on these insects?

In reply it may be pointed out that in the experiments the behaviour of the birds of ten distinct genera, belonging to five bird families, was so consistent and so nearly uniform that it could not be inferred that any one species was less discriminating in its selection of insect food than another. Even putting aside the natural and justifiable inference that some bird-species not participating in the experiments would be similarly influenced in their food preferences, it may be confidently asserted that these ten, of wide distribution and of great individual abundance, include and constitute a large proportion of our bird population which by size and habit are potential enemies of insects of the general character of those used in experiment. The relative unacceptability of some of these insects to a large percentage of the bird population of their habitat, alone must constitute a not insignificant factor in their survival.

Explanation of Plates XVI and XVII.

Plate XVI.

Moths of gaudy coloration.

(Natural size.)

Syntomeida ipomeae Harr.

Spotted with white; banded with orange rufous.

Rating, 12·2.

Syntomeida epilais Wlk.

Spotted with white; abdomen tipped with scarlet.

Rating, 0·0.

Utetheisa bella L.

Fore-wings yellow to coral red, with white and black markings; hind-wings pink and black.

Rating, 3·5.

Xanthopastis timais Cram.

Corinthian pink, black, and cadmium yellow.

Rating, 9·8.

Mixture of seeds and grains.

(About half size.)

Mixed in equal volumes, the relative quantities selected by the birds are indicated by the order of listing. Acceptances from the mixture were based upon bird-preferences, not upon quantities or availability.

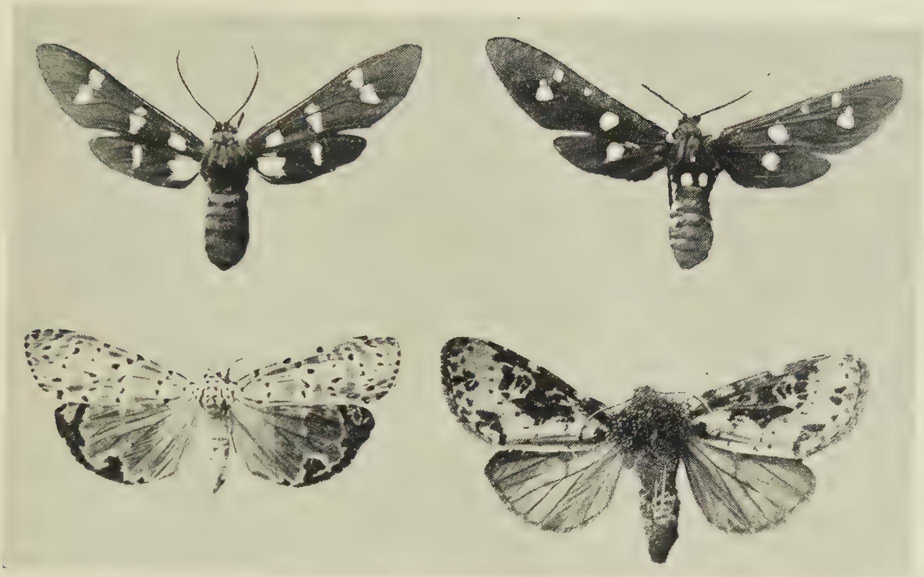
Sunflower.
" Cracked corn " (maize).
Hemp.
Yellow millet.
Kafir.
Buckwheat.
Wheat.
Rapeseed.

Plate XVII.

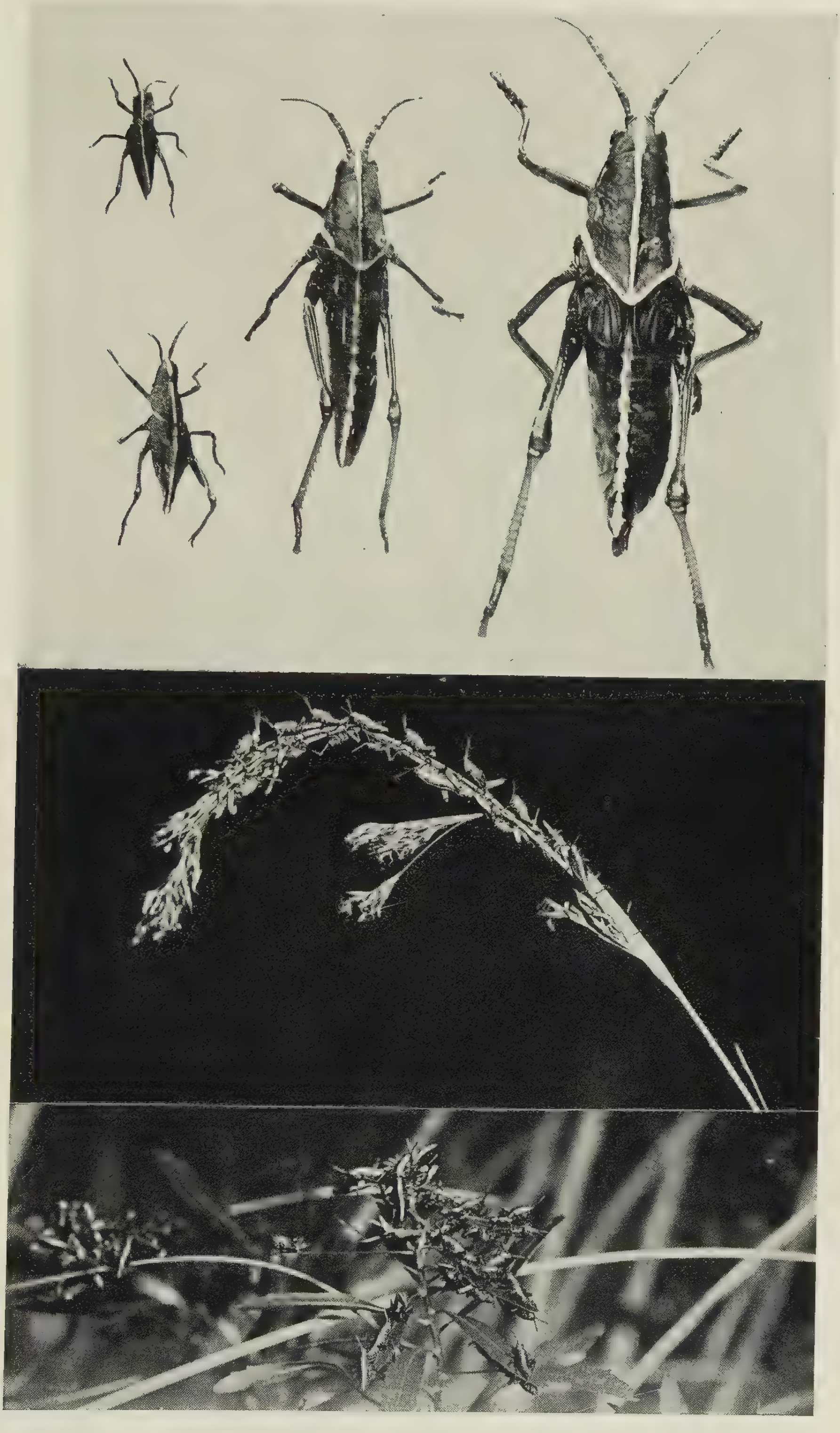
Nymphs of the "Lubber Grasshopper," *Romalea microptera* Beauv.
Shining black, striped with bright yellow.
Rating, 6·0.

Seeking elevated and exposed sleeping sites.

By day, feeding in crowded groups on low herbage.



Experiments on acceptability of insects to birds.



Experiments on acceptability of insects to birds.

NOTES ON THE BEHAVIOUR OF THE LARVAL COMMUNITIES OF *PERGA DORSALIS* LEACH (HYMENOPTERA, TENTHREDINIDAE)

By J. W. Evans, M.A.

(Division of Economic Entomology, Commonwealth Council for Scientific and Industrial Research.)

[Read 3rd October, 1934.]

With Five Text-figures.

Introduction.

The observations recorded in this paper were made as the result of a remark made by Professor W. M. Wheeler, during the course of a lecture delivered by him at Canberra, early in 1932. Professor Wheeler mentioned that a study of the relationship to each other of individuals, comprised in colonies of sawflies of the genus *Perga*, would be of great interest, since they alone of the Tenthredinidae have developed an incipient communal life, although belonging to an order of insects in which communal existence has reached a very high order of development.

Larvae of many species of sawflies are gregarious, feeding side by side and pupating in a mass; but in no other genus of the Tenthredinidae is the association between individual insects such an intimate one. Morice (1919), in a discussion of the relationships between the Siricidae and the Tenthredinidae contained in a comprehensive systematic paper on Australian sawflies, mentioned that " Sawflies form no communities." Presumably he was either unfamiliar with their larval associations, or regarded them merely as loose aggregations of individuals, reserving the term " community " for such complex associations as occur among the Formicoidea, Vespoidea and Apoidea.

Not only do the larvae of *Perga* spp. live in close proximity to each other and in some species pupate side by side, but Lewis (1837) published evidence to show that there may even be some association between individuals representing different generations. Eggs are laid between the surfaces of Eucalyptus leaves, lying in rows against the midrib, and to quote Lewis, " On this leaf the mother (*P. lewisi* Westwood) sits until the exclusion of the larvae, which appear not to remain in the ova state for many days, nor can she be made to leave the place except by actual force." He goes on to describe how the parent insect will remain near the larval colony, following it from place to place. Numerous observations have been put on record of instances of parental care amongst insects; many of these have been discredited, but the observations of Haviland (1925) and Beamer (1930) on Membracids supply apparently authentic parallel cases. Beamer even observed an adult female Membracid drive off a small wasp that approached the place where her young were feeding.

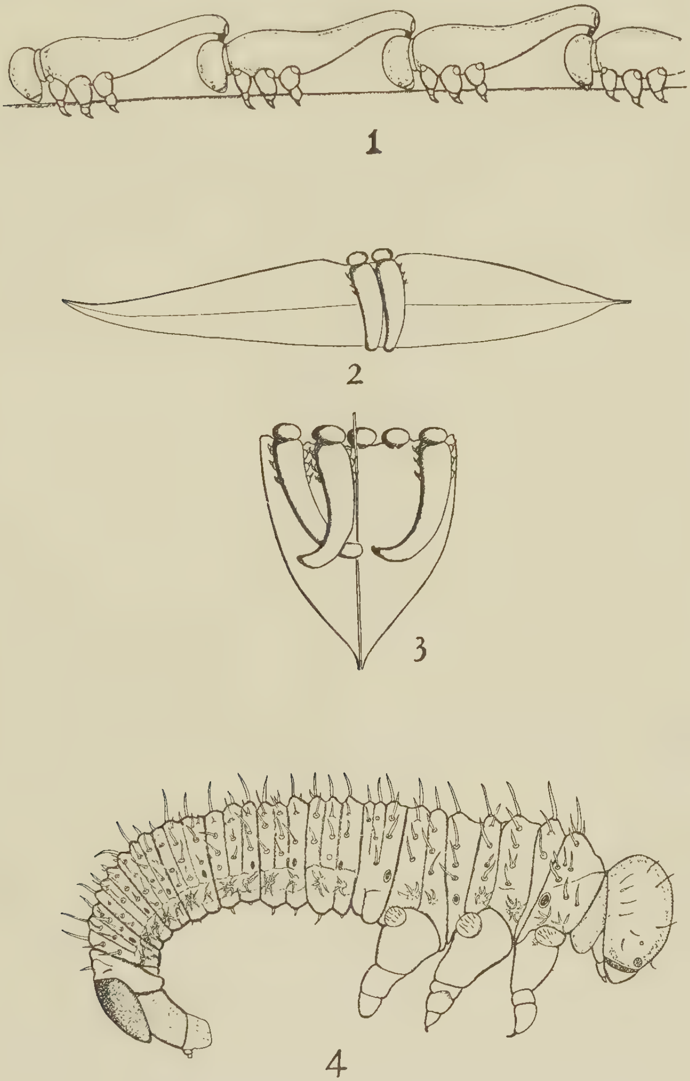
Full details of the life-histories of *Perga* spp. are given in the works of Bennett and Scott (1859), Froggatt (1890, 1901, 1918, 1923), and Raff (1930).

Extended observations have been made by the present author with only one species, *Perga dorsalis* Leach. The oviposition period extends from April to June, and larval development proceeds throughout the winter. In October or November, the larvae enter the soil and spin cocoons, though they do not become true pupae until January or February. The adult insects emerge in March or April. All stages of the life-cycle of this species are figured by Froggatt (1923).

COLONY BEHAVIOUR.

A colony (fig. 5) may consist of from a few to as many as thirty individuals, and, although more than one colony may be found on a single small tree, it is probable that they remain distinct entities during their existence, since assemblages made up of individuals of different sizes have never been found. In September 1932, three colonies of larvae were collected and confined in separate cages in the laboratory. Two of these consisted of *P. dorsalis*, the other comprised four individuals of another species, probably *P. lewisi.* After twenty-four hours in confinement, four larvae from each colony were placed together. Almost immediately they separated into two groups, one consisting of the larvae of *P. lewisi*, the other of *P. dorsalis*. The representatives of the two colonies of *dorsalis* that amalgamated so readily were not in the same instar, one colony consisting of individuals about an inch in length, while the others were nearly two inches long. Occasionally one or two individuals are found on a tree separated from the main mass, though this is exceptional. In order to determine how long a broken colony would take to reform, twelve larvae were placed on a small Eucalyptus branch, each individual being at least an inch away from the next one. Half an hour after separation the following groups had been formed :—5–2–2–2–1 ; five minutes later the groups were 7–3–2, and after a further five minutes, nine larvae were clustered together on a branch, and three were intertwined together on the floor of the cage.

Normally larvae remain in a dense cluster during the day, only moving in search of food at night-time. This rhythm may be upset if they are starved for a day or so, when, under pressure of hunger, they will change their habits and move during the day. When in a cluster they all lie the same way, and if disturbed will throw back their heads, exuding from their mouths a large drop of a thick yellow liquid, smelling strongly of eucalyptus; at the same time their abdomens are raised, and may be held motionless, or waved up and down, till they consider the danger passed. They travel either in a huddled column or in single file, each individual keeping in touch with the party. When the leader or leaders stop, the whole column stops; there is no pushing or hustling. As soon as the leaders move, the whole colony moves with them; there is no delay. Fig. 1 is a diagrammatic representation of progression in single file. The larvae keep in touch with one another either by resting their anal segments lightly on the head or thorax of the individuals behind them, as shown in the figure, or by curving the posterior halves of their abdomens partially round the thorax of the larva behind. The hindmost individual, any larva that gets separated from the main party, or a larva at the side of an irregular column, who is not in touch with a following insect, will set up a rhythmical tapping with the end of its abdomen. Sometimes the anal segment is beaten on the branch or ground, but more often the chitinised posterior dorsal abdominal shield (fig. 4). This tapping is audible, and larvae separated from the main column will turn in the direction of the sound and rejoin their fellows. When a mass movement is in progress and several larvae are intertwined with each other and moving side by side, a rustling sound is heard; this is probably caused by the rubbing together of the body hairs, more especially those situated on the boss-like protuberances on the femora of all three pairs of legs. On one occasion the two hindmost members of a column were separated slightly from the rest. Almost immediately they turned round and moved off together in the opposite direction, but stopped as soon as the main column halted. As soon as the latter moved again and the rustling noise was evident, the two isolated ones also began moving, turned round and regained the column. All movements are slow and deliberate, and



FIGS. 1–4.—(1) Diagrammatic sketch to show a method by which larvae of *Perga dorsalis* Leach may keep in touch with each other, when on the move. (2 & 3) Diagrammatic sketch of larvae of *P. dorsalis* in the act of feeding. (4) *P. dorsalis*; full-grown larva.

"agitation" is displayed only by individuals with no immediate followers, who may as soon as a colony halts commence a frantic tapping, which is sometimes taken up by the whole party.

It is interesting to conjecture whether the mass migration habits of certain South American sawfly larvae (*Didaeros* sp.), as recorded by Wheeler and Mann (1923), are indicative of anything more than a chance similarity of habit.

FEEDING.

These insects are voracious eaters and a few colonies on a small tree will strip it entirely bare of leaves. After a colony has left its daytime resting position (fig. 5), it will advance along a branch until the leaders reach the apical leaves, when feeding will begin. The colony may then become split up into small parties which stray down side branches, but they all link up again on the homeward march. Figs. 2 and 3 are diagrammatic drawings of larvae in the act of feeding. In fig. 2, two larvae are seen resting side by side, their abdomens curled round the edge of the leaf. In fig. 3, three larvae are seen feeding on the near side of a leaf and two on the other.

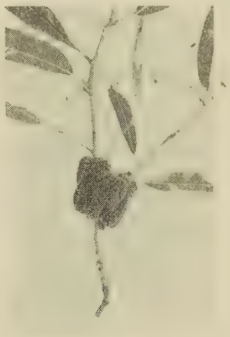


FIG. 5.—A colony of *P. dorsalis* in its usual daytime resting position.

FOOD.

Perga larvae will feed only on Eucalyptus leaves and have been found on a number of different species. Froggatt (1890) was able to breed larvae of six species of *Perga* on *Eucalyptus corymbosa*, in captivity. The larvae of *P. dorsalis* reared by the present writer were all taken on *E. obliqua*, a tree not available near the laboratory at Adelaide. Accordingly two colonies collected on September 4th, 1932, were supplied with the leaves of *E. odorata*; this they refused to touch and on the 6th were placed in a cage containing small branches of *odorata*, *leucoxylon* and *rostrata*. On the 7th they began to eat the leaves of *E. rostrata*, feeding during the daytime for seventeen days, at the end of which time they resumed their normal routine of resting in a mass during the day and feeding only at night. On 3rd July, 1933, a few individuals from each of five colonies were brought into the laboratory and placed together in a cage; on the 4th, they were found huddled in a mass. They commenced feeding four days later, and fed for three months on the leaves of *E. rostrata*. At the end of this period, six individuals from this colony were placed with six slightly larger ones found in the field. They formed a mass as before, but, once amalgamated, although none of the larvae was full-fed, they stopped eating, and eventually all died of starvation. Evidently the representatives of the new colony had become too accustomed to their original food-plant to suffer a change so late in life, and of especial interest is the fact that they prevailed on their new companions to starve as well, rather than break the association and act on their own initiative.

ECDYSIS.

Larvae contrive to cast their skins while surrounded and crowded by their companions. Ecdysis was observed with two individuals of a colony of which all the other members had cast their skins on the previous day. The two larvae were resting side by side in the middle of the group, and for half an hour kept up a regular rhythmical movement, every two seconds swaying their heads to one side, and at the same time swinging their abdomens in the opposite direction. Eventually one stopped swaying, and, after freeing its head, bent its head and thorax right back, thus pulling out the fore-gut. After this movement it remained motionless for a few minutes, then followed in quick succession three backward lunges, which freed the gut completely. It rested for a few moments and then moved forwards a little before divesting itself of the rest of the skin. Approximately thirty-five minutes elapsed between the splitting of the head capsule and the final abandonment of the old skin.

PUPATION.

It has already been shown how a few members of a colony may influence the behaviour of the remainder. Another striking case was observed with a colony just prior to pupation. On 21st October, 1932, it was noticed that a single individual of a homogeneous colony was apparently ready to pupate, since it had left the colony and was wandering about the floor of the cage. This larva was accordingly transferred to a cage containing soil two and a half inches deep. It at once climbed up the side of the cage and began tapping with the apex of its abdomen. It was then replaced with its colony, which it again left, and on replacement on the soil, once more climbed up the side and started tapping. Three days later the whole colony, including the individual referred to above, was transferred to a cage containing soil on the bottom, and the following day they were all found clustered on the surface of the soil, none being left on the leaves. They all buried themselves the same day, going down very slowly, keeping in touch with each other all the time. On the next day the whole colony had come up again, including the individual who had first made the downward move on the 21st, and who was by this time shrunken, and had lost all its white hairs, though the other larvae were still healthy in appearance. A small branch of fresh Eucalyptus leaves was placed in the cage, the stem buried in the soil, and the whole colony placed at the base. Half an hour later a movement up the branch commenced, and next morning it was found that three leaves had been eaten during the night, and the whole colony, including the shrunken individual, clustered in its normal daytime position. Feeding continued during two more nights, and then the whole colony again descended to earth and buried themselves. When disturbed next day they were all found buried in a mass, excepting one individual, out of touch with the colony, that had already begun to web together soil particles for its cell.

Five days later all the cocoons had been completed, and were lying vertically side by side, the top third of each containing the cast larval skin, and separated from the lower two-thirds by a circular plate. In the lower compartments were contained the resting larvae.

VALUE OF ASSOCIATION TO INDIVIDUAL MEMBERS OF A COLONY.

The only value such an association of sawfly larvae can have for individual members of a colony is an increased protection against enemies. As far as insect enemies are concerned, it is doubtful whether any advantage is gained, since it is well known that these larvae are heavily infested with both dipterous and hymenopterous parasites. It is, however, probable that birds seldom or never molest a colony. The larvae are doubtless distasteful; but a single larva on a leaf might well be snapped up, whereas a full colony, their heads reared back, emitting a penetrating odour of eucalyptus, and waving their abdomens in unison, present a formidable and unappetising sight.

MORPHOLOGY.

It is not intended to give here a detailed account of the structure of these insects, but only to mention such features as have some bearing on the subject of this paper. The larvae of *P. dorsalis* are black, and have on each segment numerous white hairs arising from brown chitinous bases. In shape they resemble an elephant's trunk, tapering posteriorly, and grow to a length of approximately two and a half inches. They have no prolegs, and retain their grip by means of their strong recurved tarsal claws, and also by curling their abdomens round adjacent branches, leaves, or other larvae. The anal segment and posterior dorsal abdominal shield are brown and heavily chitinised. Apically they have a protusible pad, which is doubtless of assistance for gripping purposes. The gland supplying the repugnatorial fluid opens ventrally into the oesophagus just behind the mouth. It extends ventrally as a single body to between the second and third pair of legs, where it divides into two parts, the two divisions terminating in the femora of the hind legs.

CONCLUSION.

The extent of the association between individual larvae in a colony of *Perga dorsalis* is evidently greater than between gregarious larvae of other sawflies, and may be compared with that found between members of "processionary" caterpillars, such as *Ochrogaster contraria* Walker (NOTODONTIDAE). In spite of the fact that, in addition to larval associations, there may be an association between a parent insect and her progeny, there is little evidence to suggest, that these are preliminary stages on the way to the development of a communal life such as is found among the higher Hymenoptera.

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A CLASSIFICATION OF THE SAWFLIES OF THE FAMILY PTERYGOPHORIDAE, WITH A REVISION OF THE AUSTRALIAN MEMBERS OF THE SUBFAMILY EURYINAE (HYMENOPTERA, SYMPHYTA)

By Robert B. Benson, M.A.

(British Museum (Natural History).)

[Read 3rd October, 1934.]

With Nine Text-figures.

I. Introduction.

While naming a collection of sawflies brought to me last year by Miss L. F. Graham (Mrs. Harris), who was, before her marriage, working on Hymenoptera for the Council for Scientific and Industrial Research, Division of Economic Entomology, Canberra City, F.C.T., Australia, I was led to investigate the systematic position of those groups of sawflies peculiar to the Australian and South American zoogeographical regions. The present paper has arisen as a result of these studies.

I am much indebted to Dr. Runar Forsius of Helsingfors, Finland, for his continuous help in lending me specimens and types from his private collection for comparison and description, and to Prof. G. D. Hale Carpenter for letting me examine the type of *Clarissa thoracica* Morice from the Hope Department, Oxford.

II. *On the systematic position of the family* Pterygophoridae.

The family Pterygophoridae, as defined in the present paper, includes both the Pterygophoridae and the Perreyiidae of Rohwer (1911). Rohwer separated the Pterygophoridae by the presence of the first perapterum and sternauli in the thorax. Unfortunately the first perapterum varies greatly in size in different species and even in some *Pterygophorus* species is quite clearly indicated, as for example in *P. interruptus* Kl.; on the other hand, it is very much reduced in certain *Perreyia* such as *P. capitulum* Nort., and *P. mexicana* Cam. The sternauli (the sutures separating the mesosternum from the mesoepisternum) are also present in many species of *Pterygophorus*.

The maxillary and labial palps throughout the family are frequently reduced; though *Pterygophorus* has the usual 6- and 4-segmented palps, *Perreyia* shows different stages from 5 and 3, to 2 and 1. The antennae frequently develop distal prolongations to the segments producing, in the extreme forms, the beautiful and complex structures of the male *Cladomacra* and the male *Pterygophorus*. The anal cell in the fore-wing is petiolate in shape in the Perreyiinae, while in the Euryinae it is either petiolate or else more or less broken down. The process of breaking down has taken a different evolutionary line in *Ancyloneura*, *Conocoxa*, etc., of the Euryinae from that in *Pergula*, which is therefore put in a separate subfamily Pergulinae. In *Pergula* (fig. 1b) the cell has disappeared through the fusion of the first and second anal veins, while in *Ancyloneura* and *Conocoxa* (fig. 1c) the second anal vein has faded out apically, leaving only the free basal end. In *Pergula* therefore and many other anal cell losers, such as *Acordulecera,* the anal vein is strongly curved since the first branch of the anal vein has bent down to meet the second branch. In groups such as Pterygophorinae and Perginae, where the anal vein is almost straight, it is impossible to say whether this is a secondary straightening after passing through the curved condition of *Pergula,* or whether this has resulted from the fading out altogether of the second branch of the anal vein as is happening in Euryinae. It should be noted that in all sawflies where an anal cell is present the anal vein is straight; the curved anal vein only occurs where the cell has disappeared, and can only have arisen in the way indicated.

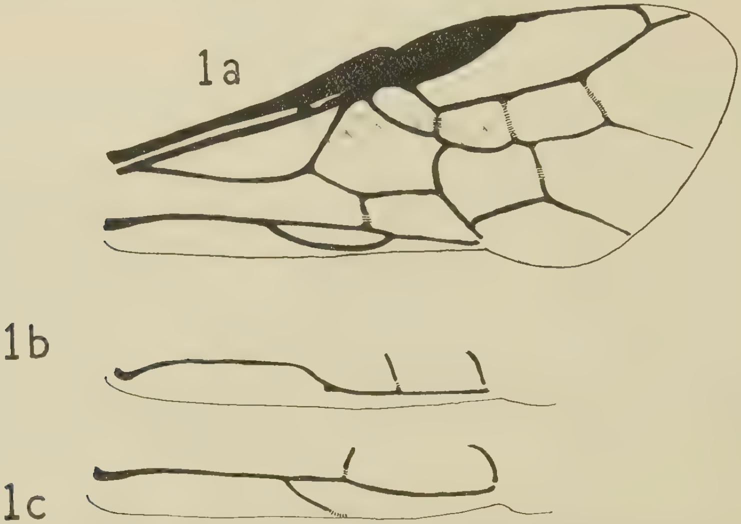

Fig. 1.—(a) Fore-wing of *Eurys laetus* Westwood; (b) anal region of fore-wing of *Pergula turneri* Morice; (c) anal region of fore-wing of *Ancyloneura nigripes* Smith.

Members of the family Pterygophoridae can be separated at once from Pergidae and Loboceridae by the absence of preapical spines on their tibiae, thus:

1. Hind tibia with a preapical spine . . . . Pergidae.
[Middle tibia also bears a preapical spine except (?) in *Paralypia picipes* W. F. Kirby, at present only known from one specimen in very bad condition; the preapical spines on the middle tibia of this specimen may have been broken off.]
– Hind tibia without a preapical spine . . . . 2.
2. Middle tibia with a long preapical spine . . . . Loboceridae.
– Middle tibia without a preapical spine . . . . Pterygophoridae.

III. *Key to the subfamilies* of the family* Pterygophoridae.

1. Both first and second recurrent veins received in the second cubital cell which is very long and consists really of the second and third cubital cells through

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* The subfamily Phylacteophaginae and tribe Acordulecerini of Rohwer, 1911, p. 225, are transferred to the Pergidae.

the breakdown of the second cubital nerve. Anal cell absent; not even indicated by the presence of a free part of the 2nd anal vein; anal vein straight.

[Radial cell of hind-wing open apically.

Antennae many-segmented; pectinate in all ♂♂ and in some ♀♀.

Larvae chiefly on *Eucalyptus* and allied plants. Genus: *Pterygophorus* Klug, Australia.] . . . . PTERYGOPHORINAE.

– Second cubital cell not as above. Anal cell present or, if absent, then either the anal vein is curved strongly or else the anal cell is indicated through the presence of a free part of the 2nd anal vein . . . . . . 2.

2. Anal cell absent in fore-wing and the anal vein is curved strongly (fig. 1b). Free part of the 2nd anal vein absent. In hind-wing the portion of the cubitus that forms the base of the radial cell is transverse (it is continued in the same direction as the portion of the cubitus that forms the base of the first cubital cell).

[Small insect. Antennae short, subclavate, 7-segmented. Radial cell in fore-wing not appendiculate; radial cell in hind-wing open at apex. Genus: *Pergula* Morice, Western Australia.] . **PERGULINAE** subfam. n.

– Anal cell in fore-wing is present (fig. 1a) or, if partially broken down and open, then the anal vein is straight and bears a free end of the 2nd anal vein (fig. 1c). In the hind-wing the portion of the cubitus that forms the base of the radial cell is longitudinal (it is not continued in the same direction as the portion of the cubitus that forms the base of the first cubital cell, but is bent back towards the base of the wing) . . . . 3.

3. First discoidal cell in fore-wing at least as broad as long. Sternauli clearly marked (separating mesosternum of thorax from mesepisternum).

[Broad winged, often large, species, frequently with pectinate antennae in ♂.

Head broader than long, often very short, and often small in width compared to thorax; maxillary and labial palpi often reduced. Radial cell in hind-wings open or closed apically; anal cell in fore-wing petiolate.

Genera: *Perreyia* Brullé, etc., in South America; *Polyclonus* W. F. Kirby and *Cladomacra* F. Smith, Austro-oriental.] . . . PERREYIINAE.

– First discoidal cell in fore-wing clearly longer than broad. Sternauli not clearly marked.

[Small species with normal wings. Antennae simple in both sexes though sometimes slightly clavate. Head often longer than broad (viewed from in front); mouth-parts may be adapted for some specialised form of feeding; maxillary and labial palpi with number of segments not reduced. Radial cell generally closed in fore- and hind-wings; anal cell in fore-wing either petiolate (fig. 1a) or, if open, then this has occurred through the partial fading out of the apex of the second branch of the anal vein (fig. 1c) and not through the fusion of the first and second branches as in PERGULINAE (fig. 1b).

Genera: *Ancyloneura* Cameron, Austro-oriental; *Eurys* Newman, *Clarissa* W. F. Kirby, *Warra* gen. n., *Neoeurys* Rohw. and *Diphamorphos* Rohw., Australia; as well as *Conocoxa* Rohw., *Haplostegus* Kon., *Nithulea* Rohw., and probably *Aulocomerus* Spinola and *Lycosceles* Kon., South America.] . . . . EURYINAE.

IV. *Australian sawflies of the subfamily* EURYINAE.

In the various attempts that have been made in the past to separate the genera of this group no attention has been drawn to the extraordinary mouth-parts of *Eurys* (figs. 4a, b and c) which separate it at once from the other genera in the group. Nothing so far as I am aware has been published on the habits to indicate the use of these elongate bee-like mouth-parts, but probably they are developed for imbibing nectar. G. Turner, 1900, pp. 516–518, records that he captured *Clarissa divergens* Kirby, and *atrata* G. Turner, always " on the blossom of a small tree or shrub growing at the edge of the scrub in January and February," and that they together with *Hylotoma apicale* Kirby (which is now known as *Antargidium apicale* Kirby) and *Pterygophorus uniformis* Kirby " are undoubtedly scrub insects." Somewhat similar elongate mouth-parts to those of *Eurys* are characteristic of the holarctic family MEGALODONTIDAE and occur also to a greater or lesser extent in individual species of other families, such as in *Tenthredo koehleri* Kl., of the mountains of central and southern Europe. Rohwer, 1910, tries to separate the genera of EURYINAE on the number of segments in the antennae. Morice, 1919, pp. 257–8, after showing that the antennal segments are variable in number separates *Eurys* from *Neoeurys* and *Clarissa* by the radial cell in the fore-wing being obliquely truncate at its apex and separated from the margin of the wing by a distinct appendicular cell, while *Neoeurys* and *Clarissa* are separated from each other chiefly by the comparative length and breadth of the antennae and legs. Rohwer, 1922, pp. 138–9, with little more success tries to use the emargination and the comparative length to breadth of the clypeus. Forsius, 1927 (1), p. 288, admits frankly that *Clarissa* and *Neoeurys* are not really distinct, but should in future be treated as one genus, and he describes new species of the genera *Clarissa* and *Neoeurys* separated provisionally and relying largely on the comparative length to breadth of the legs and antennae. Most species of this group have been described from females only and the males, which are rare in collections, are very little known. In some cases they differ so much from the females that the association of them with their respective females must await field observations or breeding results. In many species the males are still unknown to me.

V. *Key to Australian genera of* EURYINAE.

1. Mouth-parts adapted for sucking : ligula very long (fig. 4a, b and c), when extended the whole tongue (ligula and mentum) is about as long or longer than the front tibia.

[Metallic species, green, blue or coppery. Fore-wing with the first transverse vein received approximately at the middle of the discoidal cell; hind-wing with a large apical cell to the radial cell and with first sector of the basal vein equal in length or shorter than the second sector (fig. 2). Female sawsheath trifid or truncate at apex when viewed from above (fig. 5b and c). Queensland, New South Wales and Victoria. Type *Eurys aeratus* E. Newman.] . . . . *Eurys* E. Newman.

– In mouth-parts ligula is not noticeably elongate; the whole tongue is at least very much shorter than the front tibia.

[Fore-wing with the first transverse vein generally received clearly before the middle of the discoidal cell.] . . . . 2.

2. In the hind-wing the first sector of the basal vein is equal in length or shorter than the second sector (fig. 2). Female sawsheath trifid at apex when viewed from above . . . . 3.

– In the hind-wing the first sector of the basal vein is clearly longer than the second sector (fig. 3). Female sawsheath simply rounded, truncate or acuminate at apex when viewed from above.

[Fore-wing with the first transverse vein received either before or approximately at the middle of the discoidal cell. Maxillary palp always shorter than total length of head.] . . . . 4.

3. Hind-wing with a small apical cell to the radial cell, the free end of the radial

nerve being curved downwards (fig. 2). Antenna generally long and slender. Hind basitarsus long and slender; as long as the two or three following tarsal segments together.

[Queensland. Type *Clarissa divergens* W. F. Kirby.] *Clarissa* W. F. Kirby.

– Hind-wing with a very large apical cell; the free end of the radial nerve is continued in a straight line to the margin of the wing as in *Ancyloneura* (fig. 3). Antenna short and subclavate. Hind basitarsus short; shorter than the two following tarsal segments together.

[New South Wales. Type *Clarissa froggatti* Rohwer.] . . **Warra** gen. n.

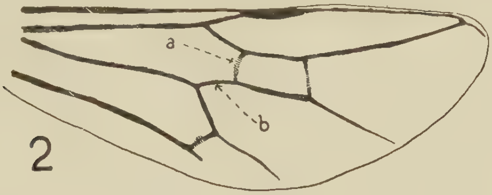

FIG. 2.—Hind-wing of *Clarissa atra* G. Turner.

4. Hind-wing with a small apical cell to the radial cell, the free end of the radial nerve curved downwards as in *Clarissa* (fig. 2). Antenna inserted very close to clypeus, at a less distance than the length of the two basal segments of the antenna.

[Maxillary palp elongate, nearly as long as length of head. Queensland, New South Wales and Victoria. Type *Diphamorphos nigrescens* Rohwer.]
Diphamorphos Rohwer.

– Hind-wing with a very large apical cell to the radial cell; the free end of the radial nerve is usually continued in a straight line to the margin of the wing as in *Ancyloneura* (fig. 3). Antenna inserted further from the clypeus than the length of the two basal segments of the antenna . . . 5.

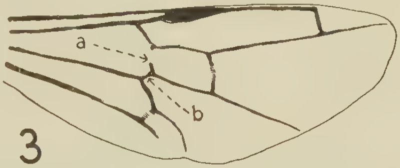

FIG. 3.—Hind-wing of *Ancyloneura nigripes* Smith. (a) = first sector of basal vein; (b) = second sector of basal vein.

5. Maxillary palp extraordinarily elongate, at least as long as the total length of the head. Antennal furrows obsolete. Hind basitarsus sometimes as long as the four following tarsal segments together, at least longer than the three following. Cheek shorter than pedicel (2nd segment) of antenna. Sector of basal vein forming base of cubital cell in hind-wing often partially broken down (fig. 3).

[New Guinea, Aru Islands. Type *Ancyloneura nigripes* (Smith).]
Ancyloneura Cameron.

– Maxillary palp normal, not nearly as long as the length of the head. Antennal furrows present. Hind basitarsus often shorter and never longer than the three following tarsal segments together. Cheek as long or longer than pedicel of antenna. Base of cubital cell in hind-wing not partially broken down.

[Tasmania, Victoria, South Australia and New South Wales. Type *Neoeurys metallica* Rohw.] . . . . *Neoeurys* Rohwer.

VI. *Eurys* Newman. *Synopsis of species.*

♀♀.

1. At least thorax bright metallic green . . . . 2.
– Thorax not bright metallic green but brassy green, coppery, or violaceous . 3.

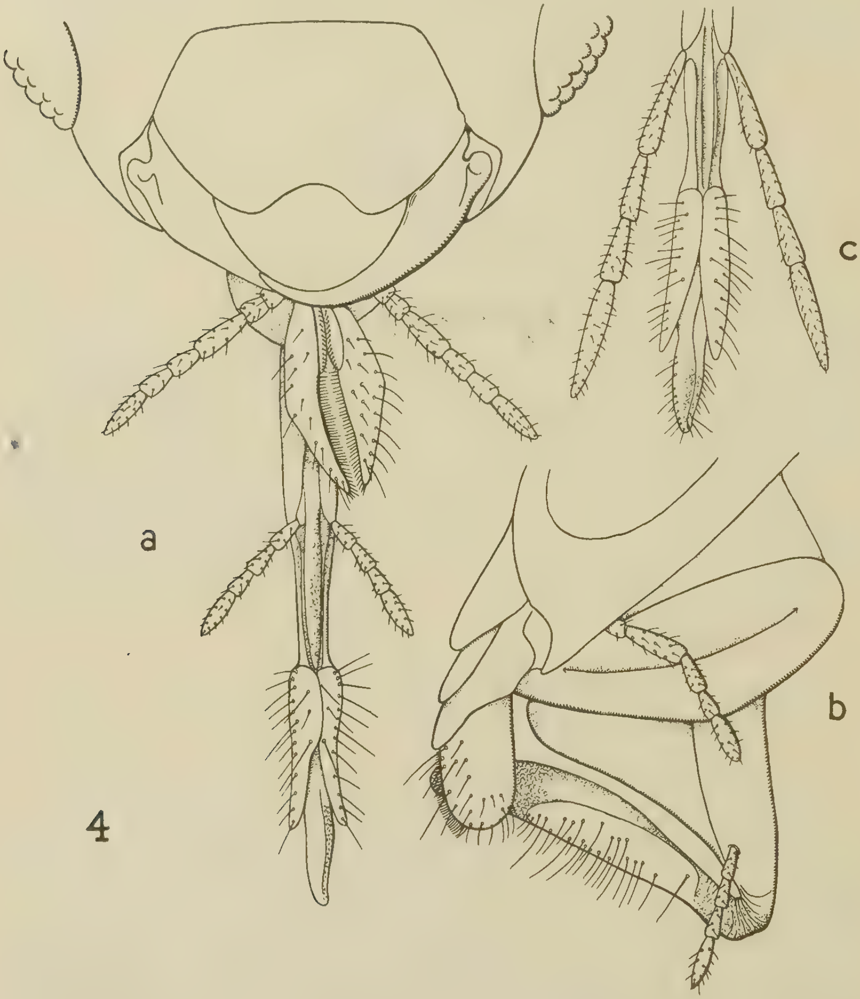

Fig. 4.—Mouth-parts of *Eurys*: (a) Mouth-parts of *E. laetus* Westwood, fully-extended and viewed from in front; (b) the same folded up and viewed from the side; (c) ligula of *E. rutilans* Morice.

2. Abdomen metallic green, without white marks down the sides. Hind femur and tibia all red.

[Legs red except for the hind coxa, trochanters and more or less the tarsi; antenna 7- to 11-segmented; labial palp at most half as long as ligula. Length 4–8 mm.] New South Wales, Victoria, Tasmania.

laetus (Westwood), 1841, p. 24, pl. vii, fig. 4 (= *nitens* Kirby, 1882, p. 95, pl. vii, fig. 5).

– Abdomen purplish-blue above except at base and apex; on each of the terga 2 to 8 the inflexed sides are marked at the hind lateral corner with a conspicuous white spot. Base of femur blackened.

[Legs with apical half of femora red, basal half together with coxa, trochanters, apex of hind tibia and more or less hind tarsi black, tibiae (except for apex of hind pair) and more or less bases of tarsal segments dirty white. Labial palpus at most three-quarters as long as ligula. Length 8 mm.] Australia, Queensland, New South Wales, and Victoria *nitidus* W. F. Kirby, 1882, p. 94, pl. vii, fig. 4.

3. Abdomen without white marks on the sides. Thorax dull, densely punctured all over. Labial palp very long, reaching almost to the tip of the ligula (fig. 4c).

[Head and thorax cupreous; abdomen dark green without cupreous tint; labrum mouth-parts, legs (except black bases to femora) red.] South Australia.
rutilans Morice, 1919, p. 296 (= *aeratus* W. F. Kirby, *nec* Newman).

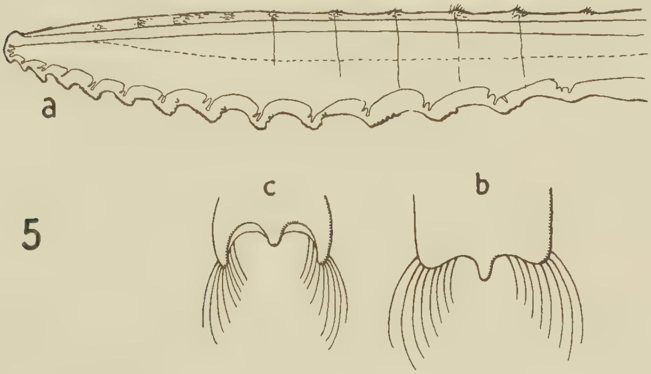

Fig. 5.—(a) Saw of *Eurys pulcher* sp. n.; (b) sawsheath of *E. pulcher* sp. n., viewed from above; (c) sawsheath of *E. laetus* Westwood viewed from above.

– Abdomen with a white mark on the inflexed side of each terga 2–8. Thorax regularly, but not densely, punctured; surface between punctures shining. Labial palp short, at most half as long as ligula (fig. 4a and b). . . . 4.

4. Head and thorax brassy green; abdomen dark blue green; the white on the side of the abdomen broken into a row of spots, each of the terga 2 to 8 bearing a white spot on the hind lateral corner of the inflexed side. Sawsheath typical of the genus (fig. 5c). Victoria.
aeratus Newman, 1841, p. 90 (= *decepta* Rohwer, 1910, p. 471).

– Head thorax and abdomen violaceous-red; the white on the side of the abdomen in the form of a broad and continuous band. Sawsheath behind very little emarginate each side of the middle, when viewed from above (fig. 5b). New South Wales . . . . *pulcher* sp. n.

In addition to these species *E. bellus* (Rohwer), 1910, p. 472, was described mostly from a single male (type in the British Museum), and the female description is very inadequate (type in the U.S. National Museum), so that the species was omitted from Morice's keys. The absence of the white band on the side of the abdomen in the female indicates that this species is not conspecific with either *E. pulcher* sp. n. or *aeratus* Newman. *E. rutilans* Morice has not got a white band on the side of the abdomen, but is separated at once by having extraordinarily long labial palps. The labial palps in *E. rutilans*

Morice (♀ type) reach almost to the tip of the elongate ligula (fig. 4c), while in all the other species of the genus known to me the labial palps are, at the most, half as long as the ligula (fig. 4a and b). The sawsheath, except in *E. pulcher* sp. n., shows little variation, and the saws are markedly uniform throughout the genus. The labial palps in *E. bellus* Rohwer (♂ type) are also shorter than in *E. aeratus* Newman (*E. decepta* Rohwer ♀ allotype).

Males.

The only males of this genus described are *E. laetus* Westwood (*Dictyura laeta* Westwood 1841, = *Euryopsis nitens* Kirby 1882), *E. aeratus* Westw. (= *E. decepta* Rohwer 1910, p. 471), and *E. bellus* Rohwer (*Euryopsis bella* Rohwer 1910, p. 472).

Eurys pulcher sp. n.

♀. *Colour* metallic violaceous-red with a greenish tinge in the sutures; black are the front margin of the clypeus, the antenna, the metanotum, the coxa and base of the femur of all the legs and basal segments more or less of the hind legs and the sawsheath; brown are the palps, the labrum, the apex of the femur, the tibia and tarsal segments of the front legs; a broad white stripe down each side of the abdomen is caused by the white margins to the inflexed sides of the abdominal terga. *Wings* hyaline; costa black; stigma and venation fuscous; base of stigma with pale spot. *Length* 6 mm.: fore-wing 6 mm.; antenna 3 mm.

Pubescence: there is a fine short pubescence over all the insect except the dorsum of the abdomen. *Puncturation:* head and thorax shining with fine scattered round punctures; abdomen dull with rugulous puncturation. *Head:* ligula and mentum very elongate (as in fig. 4a and b), the labial palp being about half the length of the glossa; maxillary palp about as long as the clypeus is broad; clypeus sharply notched in front; eyes converge slightly in front; malar space about as long as the pedicellum; median fovea large and deep, circular. Antenna 11-segmented, almost filiform; no segment broader than long. *Thorax:* scutellum slightly margined on the hind end of the raised face. *Legs:* hind basitarsus equal in length to the two following segments. *Abdomen:* sawsheath viewed from above (fig. 5b) almost truncate behind with central projection; saw typical for genus (fig. 5a).

New South Wales, near Mittagong, 1 ♀ (Holotype), 12.viii.1930 (*L. F. Graham*). (Canberra Museum.)

VII. *Clarissa* W. F. Kirby. *Synopsis of species.*

As a result of the new definition of this genus given in the key above, the two species *Clarissa froggatti* Rohwer and *C. anomocera* Rohwer must be transferred to *Warra* gen. n.; while *Clarissa carbonaria* Forsius, *C. inconspicua* W. F. Kirby, and *C. variabilis* Forsius must be transferred to *Neoeurys* Rohwer.

The saws in all the species of *Clarissa*, as redefined, except in *C. flavicornis* sp. n., are very like the one illustrated for *C. ruficollis* sp. n. (fig. 6b); the uniformity in the saw characters between these four species is quite remarkable.

Females.

1. Pedicellum clearly longer than broad; clypeus about ⅔ as long as broad.
    [Hind basitarsus equal in length to the three following tarsal segments.] 2.
- Pedicellum broader than long; clypeus not more than ½ as long as broad.
    [Hind basitarsus except in *C. ruficollis* sp. n. not longer than the length of the two following tarsal segments.] . . . . 3.

2. Thorax and abdomen mostly red.
[Almost identical in structure with following but markedly different in colour. Mostly red species, but the head except for the labrum, clypeus and base of antenna is black; black also is the mesepimeron, mesosternum and metapleura of the thorax together with the last two or three abdominal segments. Legs white but all the coxae, femora, more or less the apices of the tibiae, and on the middle and hind legs the tarsal segments black.] Queensland . . . . *divergens* W. F. Kirby, 1844, p. 46.
– Thorax and abdomen entirely black except for a white spot on the side of the first tergum.
[Very like the preceding in structure but very different in colour. Black except for the labrum, front margin of clypeus, trochanters, bases of tibiae and more or less the tarsal segments of legs, also a spot on the side of the first abdominal tergum.] Queensland . *atrata* G. Turner, 1900, p. 516.
3. Thorax and abdomen all black except for a white spot on the side of the first tergum; antennae yellow. Queensland . . . . *flavicornis* sp. n.
– At least mesonotum, mesopleura and mesosternum red; abdomen all black without white spot; antennae black . . . . 4.
4. Labrum, clypeus, pronotum and legs entirely black. Hind basitarsus about equal in length to the following three segments. Antennae 11 to 12-segmented. Canberra . . . . *ruficollis* sp. n.
– Labrum, front margin of clypeus and pronotum red; legs with coxae, apex of hind tibia and all of hind tarsal segments black or at least fuscous; femora red; bases of tibiae white. Hind basitarsus not longer than the length of the two following segments; antennae 14-segmented (type). Australia, locality unknown . . . . . *thoracica* Morice, 1919, p. 300.

Males.

The only described males in this genus are those of *C. divergens* W. F. Kirby and *C. atrata* Turner. These males are very close structurally and can, so far, only be separated on rather feeble colour characters. Both are mainly black in colour with yellow legs more or less infuscated on the hind femur, apex of hind tibia and hind tarsal segments. In *C. divergens* W. F. Kirby there is a yellow band on the abdomen covering the whole of the segments 2 and 3 and often part of segment 4; in *C. atrata* G. Turner only the apices of these segments are yellow while the bases are black.

Clarissa flavicornis sp. n.

♀. *Colour* black; yellow are the labrum, front margin of the clypeus, antenna, legs (except the coxae which are black, and on the middle and hind legs the trochanters and bases of the tibiae which are white) and a spot on the side of the first abdominal tergum. *Wings* hyaline; stigma and neuration of apical two-thirds black; neuration of basal third yellow. *Length* 6·5 mm.; fore-wing 5·5 mm.; antenna 2 mm. *Pubescence* fine and regular but absent on the abdominal terga. *Puncturation:* head and thorax dull with fine surface puncturation; abdominal terga rugulously punctured. *Head:* clypeus slightly emarginate in front; malar space a little shorter than length of pedicellum; antenna 12-segmented, subclavate, segments 8 to 12 broader than long; median fovea very shallow, almost obsolete. *Thorax:* scutellum rounded behind. *Legs:* hind basitarsus about equal in length to the two following segments. *Abdomen:* sawsheath as in *C. ruficollis* sp. n. (fig. 6c); saw (fig. 6a) departs from the general type of saw in the genus (cf. fig. 6b).

QUEENSLAND, Eidsvold, 1 ♀ (Holotype), x.1929 to iv.1930 (*T. L. Bancroft*). (Canberra Museum.)

Clarissa ruficollis sp. n.

♀. *Colour* black, red are the meso-notum, -pleurae, and -sternum. *Wings* infuscated with black neuration. *Length :* 6–6·5 mm.; fore-wing 6 mm.; antenna 3 mm. *Pubescence* fine and regular but absent on the abdominal terga. *Head :* puncturation of face strong (except for the unpunctured front edge of the clypeus); back part of head less strongly punctured but yet dull on the temples; ocellar region may be unpunctured; clypeus slightly emarginate in front; malar space about as long as the pedicellum; antenna subclavate, 11 or 12-segmented, only segments 10 or 10, 11 and 12 and pedicellum, broader than long; median fovea broad and elongate in the form of a general slight depression. *Thorax :* mesonotum, especially scutellum, and mesopleura almost unpunctured; pronotum and metapleura slightly ruguIously punctured. *Legs :* hind basitarsus nearly equal to the three following segments in length. *Abdomen* with regular rugulous puncturation; sawsheath typical for the genus (fig. 6c); saw typical for genus (fig. 6b).

6

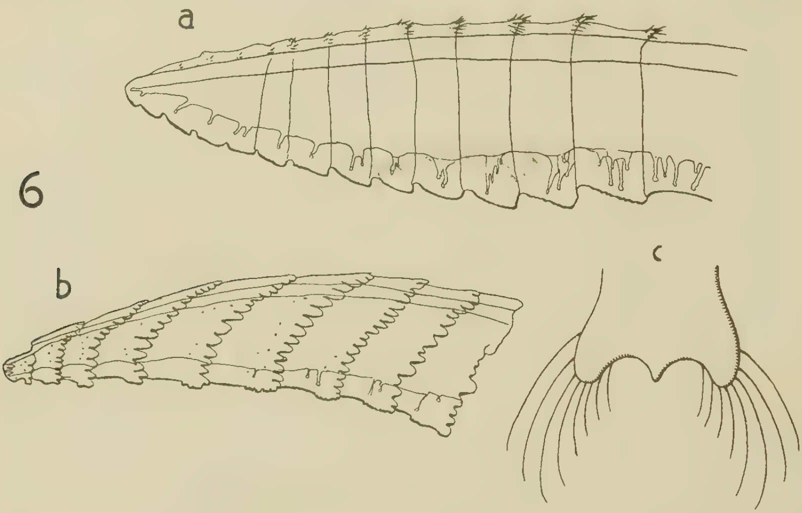

Fig. 6.—(a) Saw of *Clarissa flavicornis* sp. n.; (b) saw of *C. ruficollis* sp. n.; (c) sawsheath of *C. ruficollis* sp. n., viewed from above.

Australia, Federated Capital Territory, Blundells, 1 ♀ (Holotype), 26.ix. 1930 (Canberra Museum); 1 ♀, 10.x.1930, and 1 ♀, 21.i.1931 (British Museum) (*L. F. Graham*); 1 ♀, 15.ii.1929 (*G. F. Hill*) (Canberra Museum).

VIII. **Warra** gen. n. (genotype *Clarissa froggatti* Rohwer).

Synopsis of species.

This genus, for a definition of which see key on p. 465, is erected for the two species *Clarissa froggatti* Rohwer and *C. anomocera* Rohwer which can be separated thus :—

Males and females.

1. Abdomen ferrugineous except for the sheath in the ♀, the sides of the first abdominal segment and the middle of the apical segments.
   [Head and thorax black except for the palps, pronotum sometimes, the sides of the prescutum, scutellum and tegula ferrugineous. Legs black except in the ♀ the four front tibiae, the extreme apex and basal half of

the hind tibia and the apices of the tarsal segments which are ferrugineous (in the ♂ the four front femora except the base of middle pair, together with posterior tibia and tarsi are also ferrugineous). Antenna very short, clavate, 9 to 10-segmented, pedicellum and in ♀ segments 5 to 9 or 10 broader than long (in ♂ segments 6 to 8 are only as long as broad). Length, ♂, 5 mm.; ♀, 6·5 mm.] New South Wales
froggatti (Rohwer), 1922, p. 92.

Abdomen dark metallic green.
[Metallic green species; apices of femora, the tibiae and bases of the tarsi white. Antenna 8-segmented; in ♀ segment 3 = 4 + 5 in length and 7 is as broad as long; in ♂ 3 is less than 4 + 5 in length and 7 is longer than broad. Length, ♂, 4·5 mm.; ♀, 4·5 mm.] New South Wales . . . . *anomocera* (Rohwer), 1922, p. 93.

IX. *Diphamorphos* Rohwer. *Synopsis of species.*

Males and females.

1. Hind basitarsus clearly longer than the three following tarsal segments together. Hind femur entirely yellow.
[♂: Small specimens (3 mm.) all black except for legs which are yellow, infuscate on the apex of the hind tibia and more or less on all the tarsi; antennae 16-segmented; hypopygium emarginate behind. ♀: 3·5 mm.; head and thorax all black; abdominal segments 1 to 4 entirely yellow; legs (except hind tarsi apically) all yellow.] Queensland
minor Rohwer, 1910, p. 474.

– Hind basitarsus scarcely as long as the three following tarsal segments together; hind femur infuscate apically . . . . 2.

2. ♂♂. [Antennae 19 to 20-segmented.] . . . . 3.

– ♀♀ . . . . 4.

3. Hypopygium broadly rounded behind.
[Dark piceous species; legs yellow with femora beneath, apices of tibiae and tarsi more or less infuscate.] Victoria
nigrescens Rohwer, Forsius, 1929, p. 83.

– Hypopygium emarginate behind.
[Dark piceous species with only upper part of pleurae pale brown; legs yellow with femora beneath, apices of tibiae and tarsi more or less infuscate.] South Australia . . . . *apicalis* Forsius, 1927 (1), p. 287.

4. Black except for pale labrum and apical margins of abdominal terga. Victoria . . . . *nigrescens* Rohwer, 1910, p. 474.

– Black except the following which are yellow: angles of pronotum, tegula, sides of middle lobes of mesonotum, upper part of mesopleura, as well as apical margins of abdominal terga. South Australia
apicalis Forsius, 1927 (1), p. 287.

X. *Ancyloneura* Cameron. *Synopsis of species.*

Females.

1. Fore-wing infuscate almost throughout. Sawsheath parallel-sided when viewed from above, not broadening apically (fig. 7a). New Guinea
fuscipennis sp. n.

– Fore-wing only infuscate at the apex; the base is clear. Sawsheath viewed from above very short and at least slightly broadening out from base to apex, so that it is broader than long (figs. 7b and 7c) . . . . . . 2.

2. Sawsheath, viewed from above, with short hairs, shorter than the apical breadth of the sheath and not strongly curved so that their tips do not

converge (fig. 7b). Infuscation of the apex of the fore-wing spreads over the first discoidal cell. Cubital cell of hind-wing not open basally. Antennal segment 3 clearly greater than 4 + 5 in length. New Guinea *brevisetosa* sp. n.

Sawsheath viewed from above with some long curved hairs, the longest of which are clearly longer than the apical breadth of the sheath and so curved that their tips converge and nearly meet behind the sheath (fig. 7c). Infuscation of the apex of the fore-wing does not spread into the first discoidal cell which remains clear. Cubital cell of hind-wing open basally by the breaking down of part of the basal vein (as in fig. 3). Antennal segment 3 about equal to 4 + 5 in length . . . . 3.

3. Antenna 15-segmented; four basal segments being more or less white. Femora all black (except for the pale apex of the front and middle legs). Tibiae black outside apically, white inside and basally. Hind basitarsus longer than the four following tarsal segments together. New Guinea *annulicornis* sp. n.

7

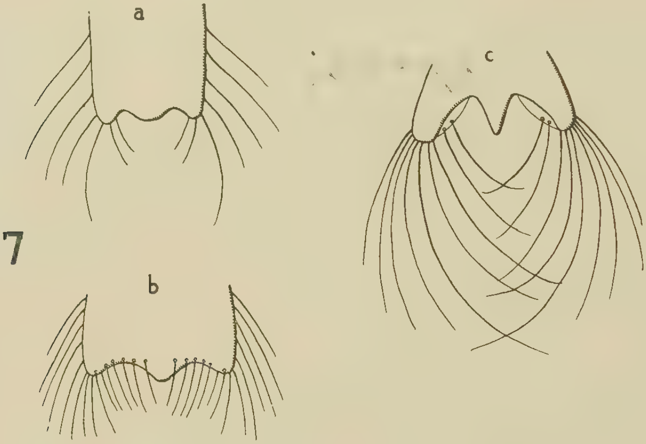

FIG. 7.—Sawsheaths of *Ancyloneura* viewed from above: (a) *A. fuscipennis* sp. n.; (b) *A. brevisetosa* sp. n.; (c) *A. nigripes* Smith.

– Antenna 11 to 12-segmented; all black. In all legs, femur (except extreme base) red, while tibia (except extreme base) and four front tarsi are sordid white. Hind basitarsus shorter than the four following tarsal segments together. Aru, New Guinea
nigripes Smith, 1860, p. 136 (= *varipes* Cam., 1877, p. 92 and *wollastoni* Rohwer, 1918, p. 438).

Males.

The descriptions of the males of *A. fuscipennis* sp. n. and *A. brevisetosa* sp. n. follow; no other males in this genus have been described.

Ancyloneura fuscipennis sp. n.

♀. *Colour* black all over except for the sordid white palps, basitarsus and more or less underside of the tibiae. *Wings* infuscate throughout, except for a small clear spot at the apex of the first discoidal cell in the fore-wing and the less infuscate base to the hind-wing. *Length* 4 mm. (abdomen badly contracted through immaturity); fore-wing 4·5 mm. *Pubescence* normal and fuscous in colour. *Puncturation* absent from most of the surface which is smooth and shining; the side lobes of the mesosternum show very shallow surface punctures and the basal terga are rugulous. *Head:* median fovea round and shallow; malar space about half as long as pedicellum. *Antenna* in the type broken off from segment 6; pedicellum as long as broad; segment 3 = 4 + 5 in length, and straight. *Wings:* base of cubital cell in hind-wing broken down in front so that the cell is not closed basally. *Legs:* hind basitarsus equals in length the four following tarsal segments together. *Abdomen:* sawsheath (fig. 7a).

♂ except in the genital segments as ♀, but the pale colour on the legs is more sordid, and more widespread over the tibiae, and the labrum is pale also. Median fovea much more strongly developed and open behind so that it joins the frontal furrow. Compound eyes much larger than in female and converge more strongly in front; the malar space is absent. The hind basitarsus is broader than in the female; at the apex it is about twice as broad as at the base. *Length* 5 mm.; fore-wing 4·5 mm.

NEW GUINEA. 1 ♀ (Holotype), Coll. P. Magretti (*B. Humboldt*) (Museo Civico di Genova); 1 ♂ (Allotype) (*A. R. Wallace*) (British Museum 1862–91).

Ancyloneura brevisetosa sp. n.

♀. *Colour* black, but the following are sordid white, the palps, the four anterior tibiae (except on the outside apically), the basitarsus and following tarsal segment, and on the hind legs the basal third of the tibia, and the extreme base of the basitarsus. *Fore-wings* with the apical infuscation covering the first discoidal cell; base of fore-wings and hind-wings almost free from infuscation. *Length* 5 mm.; fore-wing 5 mm.; antenna 2 mm. *Pubescence* normal and white. *Puncturation:* head and mesonotum (except scutellum) with regular shallow though sparse punctures; the surface shining between the punctures; terga of abdomen rugulous. *Head:* median fovea almost obsolete; malar space about as long as the length of the pedicellum. *Antenna* 12-segmented; pedicellum longer than broad; segment 3 is long, thin and curved, longer than 4 + 5. *Wings:* cubital cell in hind-wing is closed basally, the basal vein not being broken down. *Legs:* hind basitarsus longer than four following tarsal segments together. *Abdomen:* sawsheath when viewed from above, furnished with short hairs, shorter than the apical breadth of the sheath and not strongly curved, so that their tips do not converge (fig. 7b).

♂ except in the genital segments, as ♀, but the legs are unicolorous black and the compound eyes are larger and converge more strongly, so that the malar space is eliminated, the hind basitarsus is strongly broadened so that apically it is quite twice as broad as it is at the base and the other tarsal segments are also much broadened.

NEW GUINEA: South East, Moroka, 1300 m., Loria, 1 ♀ (Holotype) and 1 ♂ (Allotype) vii.–xi.1893. (Holotype in Museo Civico di Genova; Allotype in British Museum.)

Ancyloneura annulicornis sp. n.

♀. *Colour* black (piceous in parts through fading owing to the age of the specimen); sordid white are antennal segments 1–4, the tibiae on the inner side and basally on the outer side, the tarsi of the front and middle legs except at their extreme apices. Apical infuscation of the fore-wings not extending into the first discoidal cell; base of fore-wings and hind-wings clear. *Length* 6 mm.; fore-wing 5·5 mm.; antenna 3 mm. *Pubescence* normal, white though fuscous on back of head and on mesonotum. *Puncturation* very sparse; almost obsolete on temples and thorax; abdomen rugulous. *Head:* malar space very short, in the middle almost linear; median fovea connected backwards with the frontal furrow to form a shallow vague groove. *Antenna* 15-segmented; segment 3 hardly longer than 4 + 5. *Wings:* cubital cell in hind-wings open basally through the partial breakdown of the basal vein forming its basal margin (as in fig. 3). *Legs :* hind basitarsus longer than the four following tarsal segments together. *Abdomen :* sawsheath as in *A. nigripes* Smith (fig. 7c).

New Guinea : 1 ♀ (Holotype) (*A. R. Wallace*) (British Museum 1862–91).

This specimen, which is now in very bad condition, was figured by W. F. Kirby, 1882, p. 95, pl. vii, fig. 7, and the antenna in fig. 7a (in which it should be noted that segment 3 is drawn much too long in comparison with the other segments).

One other species, not included above, has been described from Argentina as *Ancyloneura joergenseni* Schrottky, 1913, *Deuts. ent. Z.*, **1913** : 703; it is not likely that this species really belongs to *Ancyloneura* which, so far as I know, is confined to New Guinea, Aru and perhaps other adjacent islands.

XI. *Neoeurys* Rohwer. *Synopsis of species.*

Females.

1. Pronotum marked with yellow . . . . 2.

– Pronotum not marked with yellow . . . . 5.

2. Sawsheath from above appears short, and rounded behind (figs. 8a and b). 3.

– Sawsheath from above appears long and either acuminate or else truncate behind . . . . 4.

3. Hind tibia and basitarsus mostly black. Hairs on sawsheath viewed from above set out at an angle and almost straight so that the tips are much further apart than the breadth of the sawsheath (fig. 8a). Median fovea joins frontal furrow as a deep longitudinal groove stretching back to the anterior ocellus. Length 5–6 mm.

[Variable in colour; in the typical form the dorsum of the abdomen more or less, and only the front part of the mesopleura (episternum) are red; in var. *collaris* Forsius, 1927 (1), p. 291, the dorsum of the abdomen is entirely black and the black of the mesosternum has spread over most of the episternum of the mesopleura; in var. *sternalis* Forsius, 1929, p. 83, the dorsum of the abdomen is black except at the apex, and the whole of the meso- and metapleura are red, the black on the under thorax being confined to the mesosternum; in var. *obscura* Forsius, 1927 (2), p. 29, the abdomen is entirely black and the pronotum yellow only on the angles.] South Australia and Victoria *variabilis* (Forsius), 1927 (1), p. 291.

– Hind tibia and basitarsus only ringed apically with black. Hairs on sawsheath set backwards and some strongly curved so that their tips from above appear much closer together than the breadth of the sawsheath (fig. 8b). Median fovea in the form of a small rounded depression. 4 mm. long.

[Sawsheath together with most of segments 8–10 of abdomen black; rest of abdomen yellow.] Queensland . *inconspicua* (Kirby), 1894, p. 47.

4. Smaller species, 3·5 to 4 mm. Sawsheath long, narrow and truncate behind when viewed from above (fig. 8c).

[Black and aeneous; mouth-parts, funiculum, prothorax, tegula, legs (except the infuscate hind tibia, tarsi and more or less front tibia and tarsi) and underside of abdomen are yellow.] South Australia
pusilla Forsius, 1927 (1), p. 292.

– Larger species, 5 mm. Sawsheath viewed from above broad and long, tapering and acuminate behind.

[Black and aeneous; mouth-parts, more or less, funiculum and pedicellum are yellow; malar space, prothorax, tegula, sides of mesonotum, and scutellum, the mesopleura, mesosternum, legs, underside and last tergum of abdomen.] Tasmania . . * *scutellata* Forsius, 1927 (1), p. 296.

5. Sawsheath from above appears very narrow and exserted almost parallel-sided, with hairs short and curved but slightly, arranged down each side of sheath (figs. 8d and g). Small species, 3·5–4 mm. long . . . . 6.

– Sawsheath clearly tapers from a broad base, with long hairs in a group each side near the apex. Larger species 5–6 mm. long . . . . 7.

8

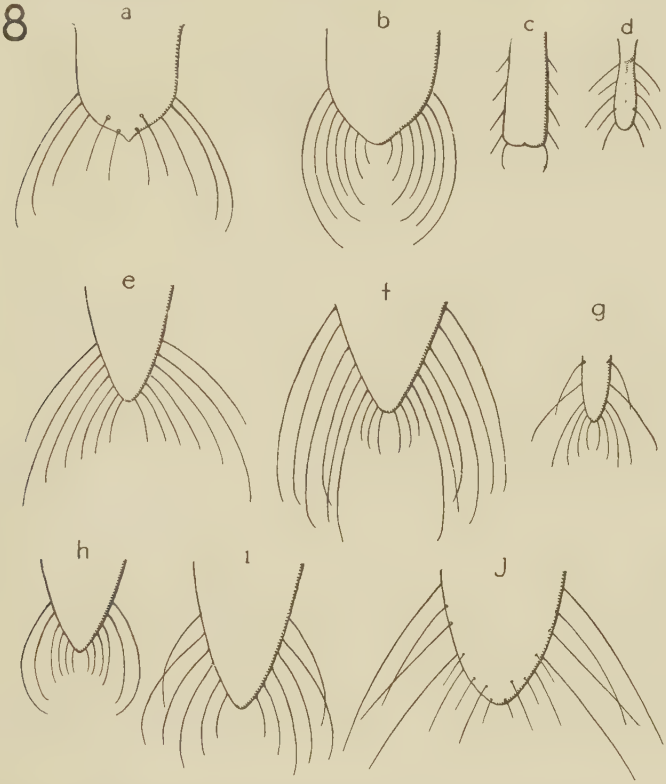

FIG. 8.—Sawsheaths of *Neoeurys* viewed from above: (a) *N. variabilis* (Forsius); (b) *N. inconspicua* (W. F. Kirby); (c) *N. pusilla* Forsius; (d) *N. leai* Forsius; (e) *N. caudata* Morice; (f) *N. ventralis* Forsius; (g) *N. affinis* Forsius; (h) *N. metallica* Rohwer; (i) *N. tasmanica* Morice; (j) *N. nigra* sp. n.

6. Sawsheath from above appears to be slightly thickened behind (fig. 8d); antenna 9-segmented.

[Aeneous on head and thorax; abdomen black; brown are the labrum and front of clypeus; yellow are femora at the apices, tibiae and tarsi (except at the apices).] Victoria and South Australia *leai* Forsius, 1927 (1), p. 243.

– Sawsheath viewed from above tapers behind and is acuminate (fig. 8g); antenna 8-segmented.

[Black aeneous species, the labrum and front of clypeus are brown; the front and middle femora (except at the base) apical third of hind femur, tibiae (except apex of hind tibia) are yellow.] South Australia *affinis* Forsius, 1927 (1), p. 295.

* The characters of the species marked with an asterisk have been taken entirely from the original descriptions as I have not had the opportunity of examining actual specimens.

7. Abdomen at least yellow at apex . . . . 8.
– No part of abdomen yellow . . . . 9.
8. Abdomen metallic black except for the whole of segments 8 to 10 and the base of the sawsheath. Sawsheath (fig. 8e); saw (fig. 9a).
[Aeneous black head and thorax; legs yellow except coxae, base of front and middle femora, most of hind femur from the base, apices of hind tibia and tarsi which are black.] Victoria and Tasmania *caudata* Morice, 1919, p. 298.
– Abdomen yellow except only for the middle of terga 1 to 7 and the tip of the sawsheath which are metallic black; sawsheath (fig. 8f); saw (fig. 9b).
[Head and thorax coloured as *caudata* Morice, except that the labrum also is yellow. These two species seem to be very closely allied and are perhaps forms of one species.] Tasmania *ventralis* Forsius, 1927 (1), p. 298.
9. Wings infuscated below the stigma.
[Wholly black species without metallic colour except for greenish sheen on the lowest part of the face; knees dirty white.] New South Wales *carbonaria* (Forsius), 1927 (1), p. 289.
– Wings unicolorous, mostly hyaline . . . . 10.
10. Malar space (shortest distance between eye and base of mandible) clearly greater than length of pedicellum; at least the head and thorax cupreous metallic; hairs on the sawsheath, when viewed from above, curved throughout their lengths (figs. 8h and i) . . . . 11.
– Malar space equal to the length of the pedicellum; black species without cupreous reflections; hairs on sawsheath, when viewed from above, either entirely straight or curved at the tips only (figs. 8j and a) . . 12.
11. Head, thorax and abdomen unicolorous reddish-cupreous; hind tibia pale yellow. Scutellum rugulously punctured. Sawsheath (fig. 8h); saw (fig. 9c). Victoria . . . . *metallica* Rohwer, 1910, p. 473.
– Head, thorax and abdomen bluish-black with bronze reflections; hind femur black. Scutellum sparsely punctured. Sawsheath (fig. 8i); saw (fig. 9d). Tasmania . . . . . *tasmanica* Rohwer, 1918, p. 439.
12. Hind tibia yellow except for the black-tipped apex. Hairs each side of sawsheath clearly curved, as in *N. variabilis* Forsius (fig. 8a); saw (fig. 9f). New South Wales . . . . *fusca* sp. n.
– Hind tibia brown except for the yellow tipped base. Hairs on sawsheath viewed from above appear almost straight (fig. 8j); saw (fig. 9e). New South Wales . . . . *nigra* sp. n.

♂♂.

The males of this genus are so little known and the available material is so uncertainly identified or in such bad condition that it is not practical to key up the species at present. What little is known about the males should be sought in the original descriptions: *N. variabilis* Forsius, 1927, p. 291; *N. caudata* Morice, 1919, p. 299; *N. tasmanica* Rohwer, 1918, p. 439; *N. inconspicua* (W. F. Kirby) Morice, 1919, p. 300.

Neoeurys nigra sp. n.

♀. *Colour* unicolorous black except the tibiae and tarsi which are usually fuscous brown (though sometimes entirely black) and the knees (extreme apex of femur and extreme base of tibia) which are usually brown especially on front and middle legs. *Wings* unicolorous hyaline to fuscous hyaline. *Length* 6 mm.; fore-wing 5·5 mm.; antenna 2 mm. *Puncturation :* the surface of head and thorax is feebly reticulate with indefinite puncturation; in places almost obsolete. *Abdomen* rugulous. *Head :* clypeus slightly emarginate on the middle of the front margin; malar space (shortest length) about equal to the pedicellum in length; antenna 10 to 11-segmented; no segment broader than long; median fovea elongate as a short deep groove; edge of ocellar basin behind notched. *Abdomen :* sawsheath with hairs on each side practically straight only slightly curved at tips (fig. 8j); saw (fig. 9e).

New South Wales : Mount Koskiusko, 7 ♀♀ (including Holotype), Diggers Ct., 5,000 ft., 10.xii.1931, and 1 ♀, Thredbor, 3,000 ft., 15.xii.1931 (*L. F. Graham*); Federated Capital Territory : 1 ♀, Blundells, 21.i.1931

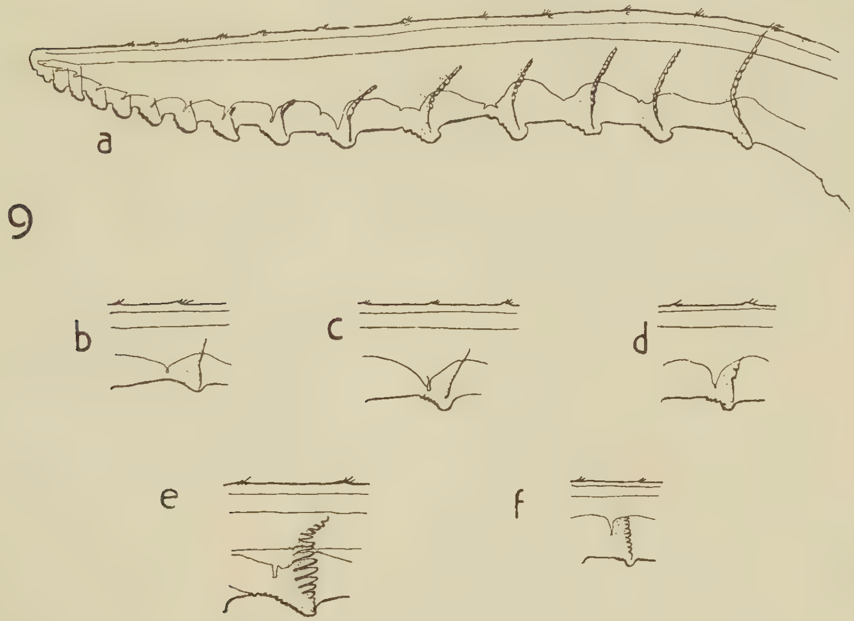

Fig. 9.—(a) Saw of *Neoeurys caudata* Morice; (b–f) 13th tooth of the saw of: (b) *N. ventralis* Forsius; (c) *N. metallica* Rohwer; (d) *N. tasmanica* Rohwer; (e) *N. nigra* sp. n.; (f) *N. fusca* sp. n.

(*L. F. Graham*). (Holotype and 4 ♀♀ from Mt. Koskiusko returned to the Canberra Museum; 4 ♀♀, paratypes, in the British Museum.)

Neoeurys fusca sp. n.

♀. *Colour* black; the labrum, mouth-parts, apex of front femur, tibiae and tarsi of all legs, except the apex of the hind tibia and more or less the hind tarsi which are infuscate, are yellow. Wings subfuscous hyaline; stigma, costa, venation brown. *Length* 4·5 mm.; fore-wing 4·5 mm.; antenna 2 mm. *Puncturation :* the surface of the head and thorax is reticulately sculptured but shining; abdomen rugulous. *Head :* clypeus truncate in front; front margin depressed and smooth; malar space (shortest length) about as long as the pedicellum of the antenna; antenna 10-segmented; no segment broader than long; segment 2 is less than 3 + 4 in length; median fovea continued in a deep groove as far back as the anterior ocellus. *Abdomen :* sawsheath with the hairs on each side clearly curved but only at the tips like *variabilis* Forsius (fig. 8a); saw (fig. 9f).

New South Wales : Botany Bay 1 ♀ (Holotype) (*H. Petersen*) (U.S. National Museum).

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Zygocarcelia cruciata, re-described, **405.**

ERRATA.

pp. 23 to 26, in title for "Crabonids" read "Crabronids."
p. 28, in explanation of fig. 1, for "pseudopodeal" read "pseudopodal."
pp. 29 to 38, for "otenate" read "ctenate" throughout.
p. 34, line 2 from bottom, for "♀-paratype" read "♀-specimen."
p. 168, line 15, for "fig. 2" read "fig. 1"; line 5 from bottom, for "fig. 4" read "fig. 5."
p. 169, line 3, for "fig. 3" read "fig. 4."
p. 172, Explanation of Pl. III, transpose "no. 1" and "no. 2" and "no. 4" and "no. 5."